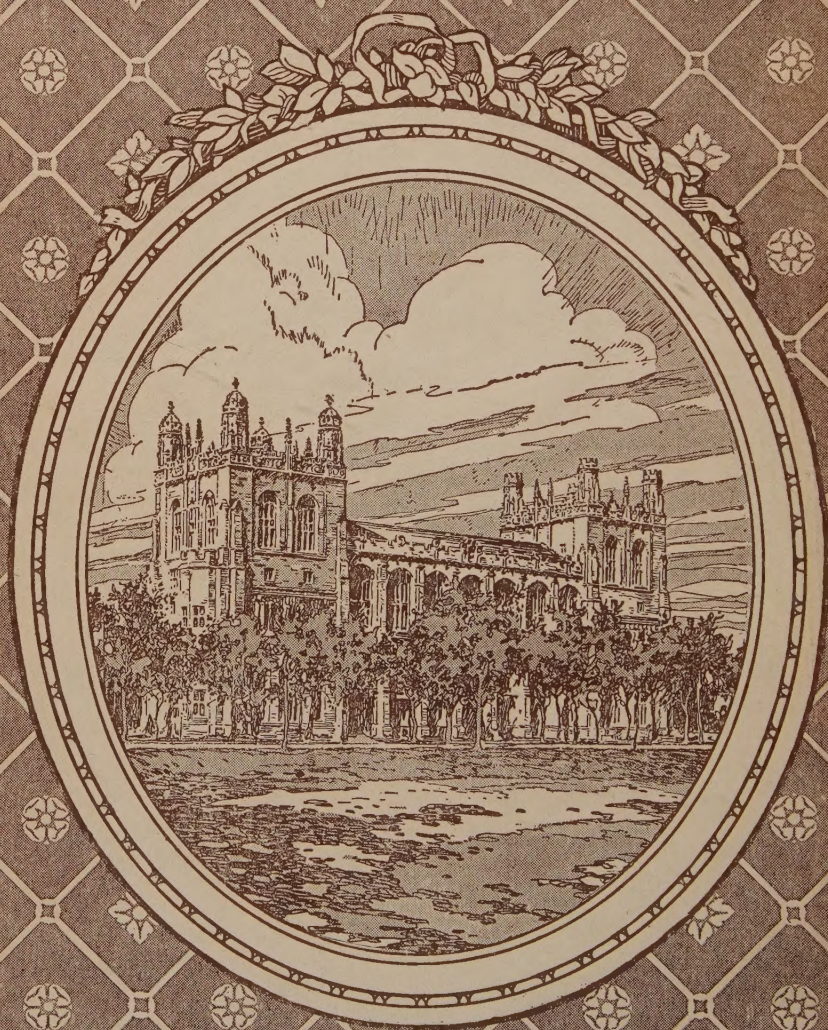






THE CLASSROOM TEACHER

VOLUME IX



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CHICAGO

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PLANT AND ANIMAL SOCIETIES



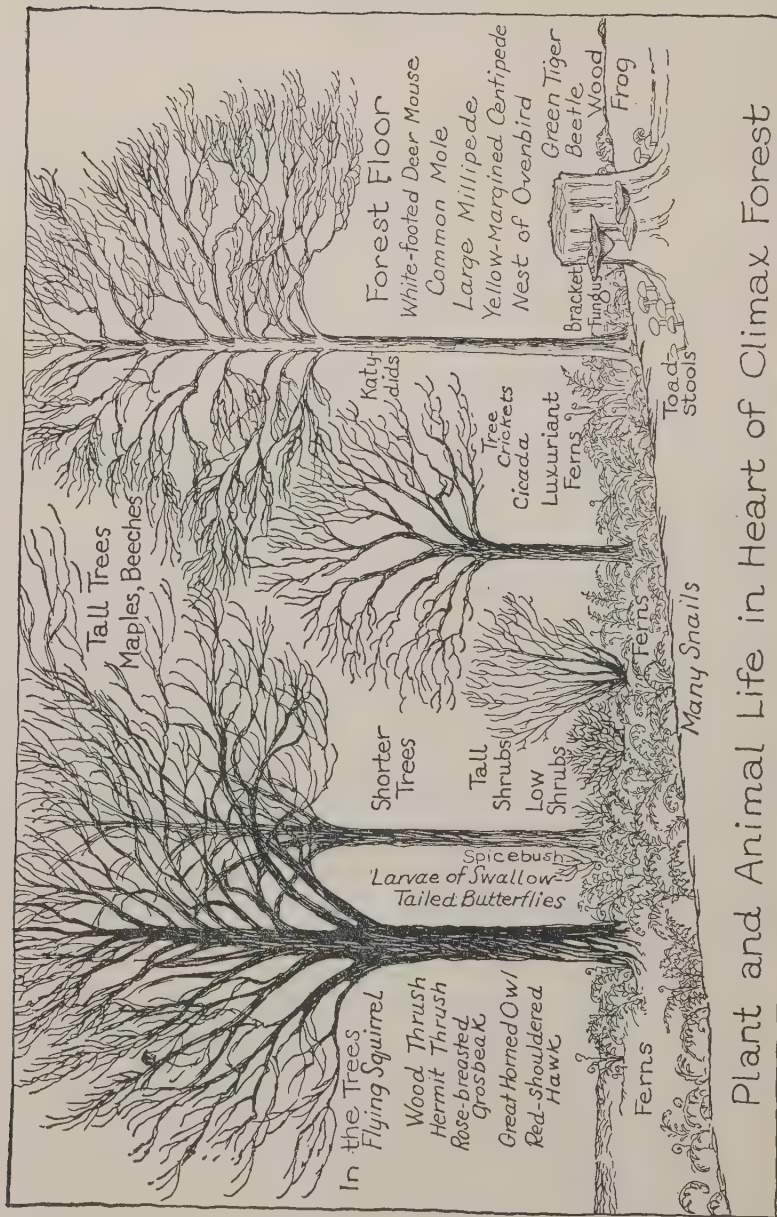
By

ELLIOT R. DOWNING, Ph.D.
Associate Professor in the Teaching of Natural Science
The University of Chicago

PLANT AND ANIMAL SOCIETIES

ANIMALS and plants are not distributed hit or miss over the surface of the earth but are to be found grouped in definite societies. In general, this is familiar to every child. One thinks of a tropical scene with its palms and bright-plumaged birds. He thinks of the forests of the temperate zone made up of maples, oaks, and similar broad-leaved trees. He imagines the woods of the North with their evergreens and pines, cedars and hemlocks; and he thinks of the regions still farther north as vast plains covered with mosses and lichens and their stunted trees and shrubs. But most people do not realize that even in the local home surroundings there are characteristic plants and animals that are confined to certain spots. When you go into a swamp you see bulrushes and cat-tails. Out on the prairie you see quite a different lot of plants. The plants that are found in these two localities are not the ones you encounter in the woods.

In this department we shall make a number of little journeys to the regions that are familiar in our home localities so as to see some of the common plants and animals that are found living together in particular environments. It will make it easier to learn to recognize plants and animals if we know which ones to expect in certain places. Thus if one knows that along the flood plain of a river the commonest trees are soft maples, white ash, sycamore, walnuts, and black willow it will be a simpler matter to find and study



Plant and Animal Life in Heart of Climax Forest

the distinguishing features of these trees than it would if all the sixty or seventy trees of the region grew there. For additional information on any of the plants or animals described, turn to the Identification Section in this volume.

A JOURNEY TO THE BEECH-MAPLE FOREST IN THE FALL

FOR our first little journey let us visit the forest of beech and maple trees. Entering such a woods we are struck at once by the deep shade. The light seems very dim and for a few minutes we shall not see things clearly, until our eyes become accustomed to the shadows. We shall next probably be impressed with the beauty of the place. These great beech and maple trunks, two feet or more in diameter, rise 50 or 75 feet before they break into branches and spread their leafy crowns perhaps a hundred feet or more overhead.

TALL TREES OF THE BEECH-MAPLE FOREST

The beech trunk is a smooth gray shaft that rises like a granite column. The leaves of the beech are small, thin, rather lance-shaped, the edges finely toothed. If we are making our visit in the late summer, probably the beechnuts are beginning to fall. These are three-sided nuts not much larger than the tip of your little finger. They are enclosed, two together, in a burr that is also three-sided.

The maples here are the hard maples, also called the rock maple or the sugar maple. The twigs on the maple tree always grow opposite each other; thus there are two at every node. Most maple leaves are five-lobed; that is, they have five major divisions that stick out from the central part of the leaf. The hard-maple leaf has a notched border but the teeth are not very numerous and the notch between the central lobe and the two adjacent ones is U-shaped.

Associated with the beech and maple trees there will be

an occasional tulip tree, black cherry, and in the moister portions of the forest, hackberry and American elms. The tulip tree is also known as the yellow poplar, and its soft wood is known as "white wood." The leaf of the tree is very characteristic, for it looks as if someone had cut off its tip with a pair of scissors.

The black cherry has a trunk whose bark is broken up into small areas so that it looks somewhat like alligator skin. Like all the cherry trees the twig has the same bitter taste that the meat inside the cherry stone has.

The hackberry can be recognized by the fact that the bark of the trunk of the tree bears numerous high corky ridges. The smaller branches of the tree are frequently infested with a fungus which causes the branchlets to grow out in clusters, many fine twigs growing together in a mass that is known as the "witches' broom."

The American elm is known by its characteristic shape, like that of a tall flaring vase. The trunk breaks up into many branches, the tips of which bend down. The twigs of the elm come off from the small branch, first one on one side, then one on the other, so that the branch is flat.

LEARNING TO KNOW THE SMALLER TREES

Below these trees that rise to great heights there is a lower stratum of trees—smaller ones that live in the shadow of the beeches and maples. Among these may be mentioned the pawpaw, the hop hornbeam, the water beech, the flowering dogwood, the redbud, the June berry, and the choke-cherry.

The pawpaw has a dark brown, smooth bark and the leaves are lance-shaped but the broad end is toward the apex. In the spring it bears dull purple flowers that are two inches across, and in the fall it will be bearing fruits something like a cucumber. The fruit is edible but to many people the taste is not very agreeable.

The hop hornbeam has a smooth gray bark; the leaves



Courtesy, U. S. Forest Service

Above is the water beech tree, with its leaves, blossoms, and bark shown at the right. The leaves of the beech are small and thin, finely toothed at the edges. The trunk is smooth and very deeply grooved. Below is the tulip tree, with its four-lobed leaf and tulip-like flower shown at the left

are thin and lance-shaped and the margins are deeply toothed. The small hard fruits are borne in clusters, each surrounded by a thin wing, the whole cluster suggestive of hops.

The water beech has a smooth trunk that is deeply grooved so that it has something of the appearance of a Corinthian or Ionic column.

The flowering dogwood has thin, rather heart-shaped leaves and in the spring it is covered with blossom clusters, made conspicuous by the four white bracts that surround each little group of flowers.

The redbud, or Judas tree, breaks into flower in the spring before the leaves appear and the tree is covered with bright red pea-shaped blossoms. These blossoms occur on numerous short branches, and even when the tree is not in blossom it may be told by these branches covered with the buds of next spring's bloom.

The June berry is also known as the sugar plum. It is a low tree with smooth bark and thin, lance-shaped toothed leaves. It is covered in the spring with white blossoms something like those of an apple tree and the fruits are red when they are beginning to ripen, almost purple when they are dead ripe.

The chokecherry in the fall will be bearing its clusters of small dark cherries about the size of peas. The clusters are cylindrical, with the numerous individual fruits given off on short branches from the sides of the main stem. These fruits are edible but puckery.

THE NEXT LOWER STRATUM—THE SHRUBS

Below the lower tree stratum will come a layer of tall shrubs—witch-hazel, spicebush, high-bush cranberry, maple-leaved viburnum, nannyberry, wahoo, leatherwood, elderberry.

In the fall the witch-hazel will be bearing its fruits. These hard green or brown pods are about as large as the end of your little finger and each pod ends in four projecting tips.



Lower left photograph by Mrs. Hoyle

Courtesy, U. S. Forest Service

From left to right, above, are the blossoms of the hop hornbeam (*Ostrya virginica*), and leaves of the hard or sugar maple (*Acer saccharum*). Below are the leaves and burrs of the beech, and the fruit of the maple-leaved arrowwood (*Viburnum acerifolium*). All of these are trees of the beech-maple forest

In time these pods as they dry contract and squeeze the little nuts out with such force that they throw them twenty or thirty feet. If you gather a few of the witch-hazel branches on which these fruits are to be found and stand them up in the schoolroom you will sometimes hear these fruits pop their seeds across the room.

The spicebush is a low shrub, the leaves of which give off a pleasant spicy odor when they are crushed between the fingers. The high-bush cranberry is one of the viburnums. In the fall it will be bearing the clusters of small red fruits, each containing a flat seed.

The maple-leaved viburnum is also a low shrub; the leaves, as its name implies, are shaped somewhat like the leaves of the maple. The wahoo is readily recognized because the twigs bear four longitudinal corky ridges so that the twig is square in cross section. The leatherwood is low—only a few feet high—and has soft white wood but very tough bark. The wood breaks readily but one must twist and pull vigorously to break the fibrous bark.

Elderberry is a shrub the branches of which have a very large amount of pith at the center. The woody layer is very thin. It will be bearing its large clusters of red berries in the autumn. These are familiar to most persons because they are used for preserves.

PLANTS ON THE FOREST FLOOR

It is evident that by the time the light has filtered down through these several layers of trees and shrubs the ground of the forest will be dimly lighted. More than that, the sun's heat is screened out, as well as the light. The forest floor is therefore cool and moist. The numerous rootlets of all these trees and shrubs make the soil spongy, so it holds a good deal of water. This forest floor is frequently covered with a dense growth of ferns and with many patches of mushrooms. The ferns that are present most commonly are the beech fern, maidenhair, wood spleenwort, lady fern,

the Christmas fern, the pale wood fern, the margined fern, florists' fern, and the ostrich fern. The fall of the year is the best time to learn to recognize these ferns because then one will find the little clusters of spore cases on the backs of the leaves, by means of which the ferns are most readily distinguished.

The beech fern has these clusters of spores along the margins of the leaves on their undersides and the fruit dots are not covered by any scale. The lowest pair of leaflets that make up the entire frond are turned down and forward. The leaflets themselves, all along the frond, are cut very deeply so that they seem to be made up of still smaller leaflets. The maidenhair fern is very easily recognized for its stem is a glistening black and the leaf is kidney-shaped, made up of very many small leaflets that are somewhat semicircular. The wood spleenwort has the fruit dots borne on the veins of the underside of the leaf, and these fruit dots are covered with a semicircular scale. The leaflets that make up the frond are fairly deeply cut but not clear to the midrib of the leaflet. In the lady fern the fruit dots are in part, at least, kidney-shaped and the leaflets are even more deeply cut than in the fern previously described. The Christmas fern has a long slender leaf that remains green well into the winter. The leaflets are not deeply cut, but the margins are toothed with a broad lobe sticking forward on each leaflet. The fruit dots cluster closely along the midrib of the leaflet and are very numerous.

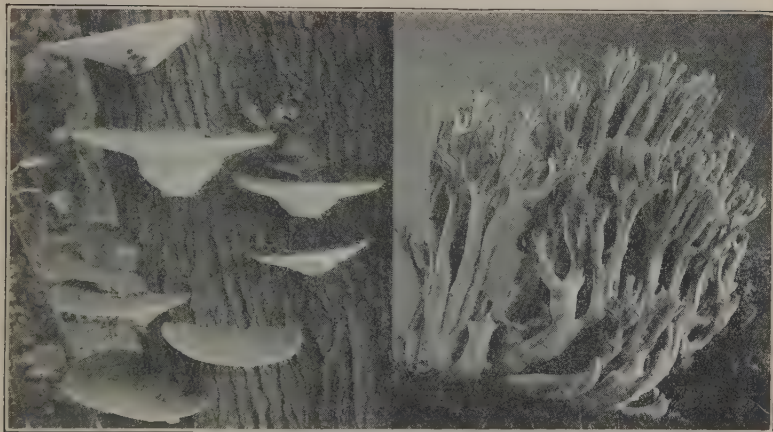
The pale wood fern has the fruit dots along the margins of the leaflets, and they are almost round. They also are covered with a scale. The frond tapers from the broadest part in the middle toward each end. The margined fern has the fruit dots right at the margin. They are somewhat semicircular in outline and the little scale is attached at its mid-point so it looks like a diminutive umbrella covering the spore cases. The leaf is thick and leathery. The florists' fern—so-called because it is frequently used by florists to put with their bouquets—has the leaflets made up of still

smaller leaflets which in turn are deeply cut. The fern leaf therefore is very lacy. The ostrich fern has its spore cases on a separate frond and this is so full of spores that the leaf does not look like a fern leaf. The segments are almost club-shaped. The leaves are all very long.

A visit will be made in the spring to study the flowering plants on the forest floor but we should watch in late summer and in the fall for two strange plants: the Indian pipe and beechdrops. In the former the flower is thimble-shaped and about the size of a thimble too. It is borne mouth down at the end of a white stem, on which are small scalelike leaves. The whole plant is ghostly white. Beechdrops is a slender, much-branched plant, purplish or yellowish-brown. The flowers are white and purple, clustered in a loose raceme or in a denser spike. These plants draw their food from the roots of trees or from decomposing organic matter and so do not need the green coloring in their tissues that helps make the food for most plants.

It would be impossible to undertake to describe the numerous kinds of mushrooms that are found growing on the floor of such a forest, for they mount up into the hundreds. Sometimes people call those mushrooms that are poisonous *toadstools*, but that is not a good use of the term, for the terms are used interchangeably and it is better to speak of the edible mushrooms or toadstools and the poisonous ones. There is no general rule for telling which ones are poisonous and which are edible. One must know the individual kinds; even then one must be very certain that he does know them well because some of the poisonous species look very much like their closely related edible forms.

Growing out of old rotting logs one will frequently find a mushroom that is called the bracket fungus. The upper surface is woody and marked with lines of growth. This bracket fungus is semicircular in shape. The under portion is frequently white and powdery in appearance and pictures may be scratched upon its surface with a pen. As in nearly all these mushrooms, the conspicuous visible part is



On the left is shown the bracket fungus (*Tomes applanatus*); on the right, the coral fungus (*Clavaria aurea*)

really only the fruiting portion. The under surface of this bracket fungus is pitted with thousands of tiny openings into the tubes where the spores are formed. When the fungus is really ripe these spores dust out in clouds, and when they find lodgment in some other rotting tree trunk they start the growth of a new plant. The bulk of the plant is in the rotting wood, and when one breaks open such a rotting log he finds the wood is filled with numerous fine white threads that make up the real body of the fungus.

Another common fungus on the floor of the forest—one that usually grows from the ground—is the coral fungus. As the name implies, it looks like a piece of coral with numerous smooth white cylindrical, almost fingerlike projections coming up from the main stalk.

ANIMAL LIFE ON THE FOREST FLOOR

These many mushrooms are interesting not only in themselves, but they are the food plants for a whole group of insects that live upon them. Break open almost any one of the toadstools that you find growing, especially if it is reasonably matured, and you will find in it the larvae and adults of dif-

ferent kinds of gnats and beetles that are feeding upon its succulent tissue.

So we shall expect to find that not only are plants arranged in definite societies but that since certain animals feed only upon certain plants there will be similarly a grouping of animals in definite associations. Here upon the floor of this forest where the fungi and molds are growing abundantly we shall find many animals that feed upon them. The snails, for instance, are very abundant. If you peel off the bark from well-decayed logs or stumps, or roll over logs or stones, you will discover a number of snails and slugs. One of the largest of the slugs is a slimy creature two or three inches in length and as large around as one's little finger. It is gray, mottled with light and dark patches. When you discover it under the bark it probably will be drawn up into a lump, but if you do not disturb it, it will proceed to crawl off, leaving a slimy trail behind it, and as it crawls you can see at the forward end of the animal a pair of feelers and also a pair of slender projections looking like feelers but each bearing at its tip an eye. These movable eye stalks enable the animal to see readily in all directions. This slug is very much like a snail except that it does not bear a shell into which it can retreat when disturbed.

Probably the most abundant of the snails will be the white-lipped snail. The shell of this animal is an inch or so in diameter. The margin of the opening of the shell is thrown back and covered with a pearly-white secretion.

Another common snail has numerous fine dark lines running from the mouth of the shell up the spire. This is known as the many-banded snail. Still another has three conspicuous teeth projecting into the opening from the margin and is known as the three-toothed snail. One with alternate patches of dark and light all the way up the coil of the shell is *Pyramidula alternata*. If these snails are taken home and put into a fruit jar in the bottom of which is some moist earth, they will live very comfortably and may be fed on lettuce.

Under the bark of the old logs and burrowing in their



The white-lipped snail (*Polygyra albolabris*) is among the common snails found on the floor of the forest

rotting wood will be found other interesting creatures. There is a large thousand-legs, as big around as a pencil and two or three inches long. It is made up of many rings and each ring bears a pair of legs. It has no common name but is designated by a part of its scientific name, *Spirobolus*.

There are many kinds of centipedes also. One of them is red and runs very rapidly with its jointed legs. It is commonly called the red centipede. Another one has bright yellow margins.

Boring into the rotting wood of these old logs one will find the larvae of many beetles. The most common beetle is a shiny black animal an inch or more in length; its head is armed with a horn like that of a rhinoceros. It is known as the "horned wood borer." Its larva is a large fleshy grub, two inches in length when full grown; it will be found boring in the rotting wood and feeding on the wood which it excavates from the passages where it lives.

Another very common larva in these rotting logs is a shiny brown slender larva which is known as the wireworm. It is the larva of a beetle that is commonly called the click beetle. There are several species of these click beetles, the largest of which is known as the eyed elater. This is a grayish

beetle, an inch and a quarter long, that has two conspicuous black spots on its back near the head, each spot surrounded by a ring of white. These spots look something like eyes. When this animal is laid on its back it suddenly springs up with a clicking sound as it makes a sudden movement of the joint where the abdomen hinges to the thorax, and so regains its feet.

Some woodboring beetles or their larvae not only live in dead timber but also bore into living tree trunks and help to kill the trees. Such are the locust borer, the heartwood borer of the oak, the round-headed apple-tree borer. It is wise therefore for the farmer who owns a wood lot to cut down dead trees and use them for firewood; also to clean out rotting logs lest there breed in them thousands of borers that may also attack the living trees.

In certain years the forest floor is covered with the earthy tubes built up by the larvae of the 17-year locust, or cicada, as they escape from the ground and climb onto the tree trunks to change into the adult insects. The adult insect looks like a big black fly as large as one's thumb. It is the insect whose long-drawn-out buzz is so commonly heard from the tree tops in late summer and early autumn. There are several species of this cicada, one of which does require seventeen years, roughly, for its life history. The larvae feed underground on roots of plants; then when full grown they bore their way to the surface and change to the adult insects. The larva climbs up a little way on the trunk of the tree, then goes into a resting stage (the pupal stage) and in the course of a few weeks this pupa changes to the adult as it molts its old pupal skin. These cast-off pupal skins will frequently be found adhering to the bark of the tree after the adult has flown to the tree top where it lives.

There are other species of the cicada that require less time for their life history. Nearly every year one will find the tubes at the top of their boring and the cast-off molt skins fairly abundant, but in some years when the conditions are particularly favorable for their breeding they come in

countless hordes. There is one species that has a black mark on the wings shaped much like a W, and unenlightened people have thought that when this insect appeared in great numbers it was announcing the coming of a war.

Another characteristic animal of the ground stratum in the beech-maple forest is a pretty little brown frog about two inches long that has a broad black stripe leading down from its eye along the margin of its mouth. This animal is so characteristic of such a locality that it is commonly called the wood frog.

INSECT LIFE IN SHRUBS AND TREES

Some of the forest shrubs and trees are the food plants of characteristic animals. Thus, the spicebush is particularly attractive to the larva of the green clouded swallowtail butterfly, and the pawpaw tree is the food plant of another swallowtail—the *Papilio ajax*. These swallowtail butterflies all have a long slender projection on the rear margin of the hind wing. Both of these butterflies are fairly good-sized, measuring three inches across the wing and the wings are marked with alternate bands of light and dark color. In *Papilio ajax* the colors are yellow and black; in the spicebush swallowtail they are somewhat similar but clouded with green.

The shrubs, and even the trees of such a forest, are the homes of numerous species of tree crickets. These insects are not at all like the familiar cricket that one sees under stones or along the margins of sidewalks. They are gauzy-winged creatures, green in color, an inch or somewhat less in length. They have long hind legs similar to those of the grasshopper and very long and slender feelers. At night in the country, especially in the late summer and early fall, the notes of these crickets are a conspicuous element in the night sounds. They chirp with persistent regularity so that the night air throbs with their intermittent songs. If you throw the light of a flashlight on the low shrubs of this forest you will see these insects as they emit their notes.

THE BIRDS OF THE BEECH-MAPLE FOREST

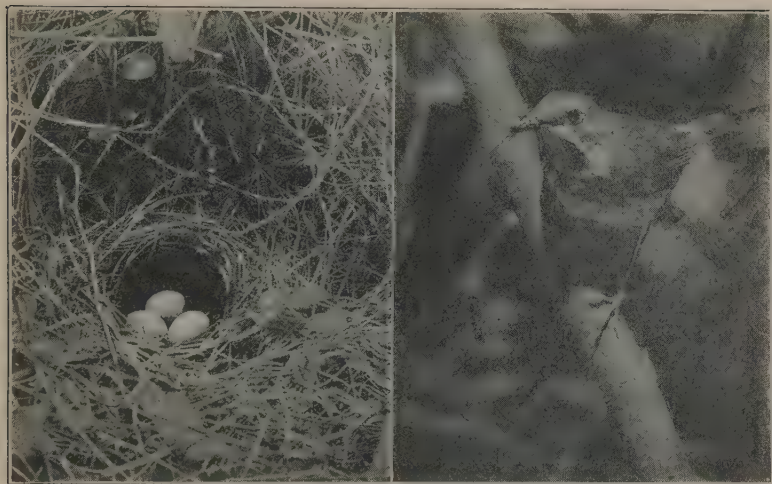
Certain birds make their home here in this deep forest and are characteristic of it. Such are the ovenbird, the wood pewee, the wood thrush, the scarlet tanager, and the great crested flycatcher.

The ovenbird you will know by its call long before you know it by sight. It says time after time, "Teacher, teacher, teacher," each call louder than the preceding one. It gets its name of "ovenbird" from the fact that it builds its nest on the floor of the forest and arches it over with dead leaves and grasses—somewhat resembling an old-fashioned Dutch oven.

The wood thrush and the hermit thrush are birds slightly smaller than the robin, brown in color, with the breast mottled with dark spots. In the hermit thrush the tail is a bright reddish-brown, much brighter than the back. The spots on the breast of the wood thrush are large and round. The notes of these birds are flutelike and complicated songs,



The ovenbird conceals its nest by arching it over with leaves and grasses. The spots on the eggs make them less conspicuous



The hermit thrush is here shown with its nest and eggs

but their bell-like quality and the exquisite tones make it difficult to confuse them with any other bird songs. They are generally regarded as our most beautiful bird songsters.

The wood pewee is one of the flycatchers. Like all of these birds, it has the habit of perching on some dead tree branch and flying out in erratic flight to catch some insect, when it returns to its perch. It repeats the process time after time. Its song repeats its name—pewee—but long-drawn-out and in plaintive key. Ordinarily it says its name twice, the second time in a minor key.

A LITTLE JOURNEY TO THE OAK- HICKORY FOREST AND ITS MARGINAL ZONE

IF WE make a visit to the oak-hickory forest we shall see many of the same creatures that have been described for the beech-maple forest. The oak-hickory forest does not have so many shrubs growing in it nor are the ferns so numerous. Its floor, therefore, is more open and the shade-loving plants and

100+%
ABOVE FOREST
SURFACE OF VEGETATION

SURFACE OF VEGETATION

110%
39 ft.

60%
24 ft.

80%
15 ft.

60%
9 ft.

30%
30 ft.

24%
IN RAVINE

SURFACE FOREST

CLIMAX

SURFACE GLADE

OAK FOREST

SURFACE FOREST MARGIN

DAMP PRAIRIE

Relative Evaporating Power of Air as Influenced by Prairie and Forest Vegetation

animals are not so abundant. Ferns and fungi, snails and insect life are less numerous in both numbers and species.

TALL TREES OF THE OAK-HICKORY FOREST

The common oaks of the forest are the black, red, and white, all easily recognized. Most of the oaks have leaves that are lance-shaped with the point of the lance at the stem end of the leaf, and the margins are usually deeply lobed. The fruit of all the oaks is the acorn. It is by the characteristics of the leaves and of the acorns that the different kinds can be most readily distinguished. The leaves of the red and white oak are broadest across the middle, while the black oak has a leaf which is broadest across the outer end. The lobes of the leaf of the white oak are rounded, while those of the black and red are pointed. The red oak has a large acorn as big as the last joint of your index finger, and the cup that holds the nut is shallow like a saucer. The acorn of the black oak is small, about half as large as the last joint of your little finger, and the nut is about half covered by the cup. The white oak has a slender, bullet-shaped acorn.

In the oak woods one finds in addition to these species,



Photograph at left by F. G. Plummer

Courtesy, U. S. Forest Service

The black oak (left) and white oak (right) are described in the text

but less common, the burr oak, especially in low grounds, the northern pin oak, the scarlet oak, the chinquapin and the hill oak, and occasionally others. The northern pin oak has a broad leaf, deeply lobed, the lobes pointed. The acorn is cylindrical and rather long, and is nearly half covered by the deep cup. The scarlet oak has a very broad leaf, usually deeply lobed, the lobes tipped with very long and slender points. The acorn is short and fat, rather more than half covered by the deep cup.

In addition to these oaks, others are found, many of them in characteristic localities. Thus the burr oak, the swamp oak, and the swamp white oak grow in wet situations. The burr oak has a leaf with rounded lobes with the widest part of the leaf at the outer end. The acorn is large and the cup has a fringe of hairs around the edge. The swamp white oak has a leaf margin which is wavy. The acorns grow in pairs, each pair on a long stem. The swamp pin oak has a leaf almost as broad as it is long, the margins deeply lobed, the lobes sharply pointed. The acorn is small, only as large as the tip of the little finger, and the cup is shallow.

The hickories commonly found are the shagbark, mocker-



Photograph by R. C. B. Thruston

Courtesy, U. S. Forest Service

Among the trees sometimes found in the oak woods is the chinquapin



Photograph at left by A. T. Boisen

Courtesy, U. S. Forest Service

At the left is the pignut hickory; at the right, the mockernut hickory nut, and pignut, of which the first is the most prevalent. The trunk of the shagbark is rough with thin strips of bark that are peeling off longitudinally. The pinnately compound leaves have five to seven leaflets. The nut is globular, somewhat flattened, thin-shelled, and white. The mockernut hickory has seven to nine leaflets on the leaf and the young leaves are hairy. The nut is globular, not flattened, brownish, and very thick-shelled. The pignut has five to seven leaflets. The nut is longer than broad, thick-shelled and bony. Its meat is oily and bitter when chewed, though at first sweet to the taste.

FALL FLOWERS AND FRUITS IN THE OAK-HICKORY FOREST

In the autumn under the oaks and hickories there is often a blaze of color, for goldenrods, asters, and some species of sunflowers are in full bloom. The elm-leaf goldenrod has, as its name implies, leaves shaped like those of the elm tree. The stalked heads of flowers are borne on the upper sides of long curving branches, the lower ones the longer, that come

out near the top of the tall stem of the plant, giving it a feathery appearance. Another species (*Solidago speciosa*) has the blossom heads in a wand-like cluster at the top of the tall plant. Its leaves are long and narrow and taper to both ends.

A white aster with heart-shaped leaves (*Aster cordifolius*) is abundant, while the common purple one with smooth stem is probably *Aster laevis*. Indian plantain is much in evidence. The individual white flowers are small and tubular, but are grouped in heads and the heads clustered in a flat-topped mass. The plant is tall with alternate broad heart-shaped, fan-shaped, or kidney-shaped leaves.

One usually comes out from a walk through the oak-hickory forest in the autumn with clothing stuck full of a variety of burrs, a demonstration of the efficiency of many devices to insure seed distribution. The fruits of tick trefoil are shaped like a very flat bean and often stick on in rows of three or four, since they grow in that way on the plants.



Photograph by A. S. Bickmore

Courtesy, U. S. Forest Service

The trunk of the shagbark hickory, showing thin strips of bark peeling



At the left is the showy tick trefoil (*Meibomia canadensis*); at the right, the fruit of the white baneberry (*Actaea alba*)

The long slender black seeds of sweet cicely adhere by one pointed barbed end. The small round burrs of black snake-root are covered with numerous hooks. The flat oval seeds are probably those of hound's tongue.

There are many brightly colored fruits. The red berries, splashed with white, grow in a cluster on false Solomon's seal. True Solomon's seal has a cluster of pendant blue berries, two or more in the axil of each leaf. In low ground are the bright red berries in clusters of jack-in-the-pulpit. The white berries of the baneberry are conspicuous. But these and other plants will be noted in our visit to the oak-hickory forest in the spring.

ANIMAL LIFE IN THE OAK-HICKORY FOREST

One finds in the oak-hickory forest rather more commonly than in the beech-maple forest, particularly along the open paths, a brilliant green tiger beetle. This beetle is perhaps half an inch in length. It rises from the path as you approach



Courtesy, Bureau of Biological Survey

The long-eared cottontail rabbit is common in the oak-hickory forest

and flies away from you a short distance, but alights on the path again to face the intruder. You must be quick to catch one of these beetles. The entire body is iridescent green with some yellow markings on the wing covers. It opens and closes its pair of big jaws menacingly as you hold it in your hand. It uses these jaws to capture various small insects along the woodland ways and is a veritable tiger to the small insect life.

Here in the oak-hickory forest one encounters a number of insects that are not found in the beech-maple forest and that live especially on these trees. There are oak borers, several kinds of metallic wood borers, the hickory twig girdler; there are katydids in the trees and shrubs, and peculiar species of grasshoppers on the ground. Here one finds also such mammals as the cottontail rabbit, the gray gopher, the common shrew, the jumping mouse, and the woodchuck.

The birds encountered are likely to be such ones as the chewink, mourning dove, rosebreasted grosbeak, chipping sparrow, tree sparrow, indigo bunting. The chewink, towhee, or ground robin is about nine inches long. The male has a

black head, back, and tail with chestnut sides. There are white bars on the wings and the outer tail feathers are white, showing conspicuously when the bird flies. The female has similar but much less brilliant coloring. The male's song seems to say, "Pretty bird—ha, ha, ha!"

The mourning dove is almost as large as a common pigeon. The color is dove-gray with iridescent feathers on the neck. Its note is a mournful "Coo" that sounds a long way off when the bird is really very near. The nest is a crude, almost flat-topped platform of loosely laid twigs, and one wonders how the eggs or young birds manage to stick on.

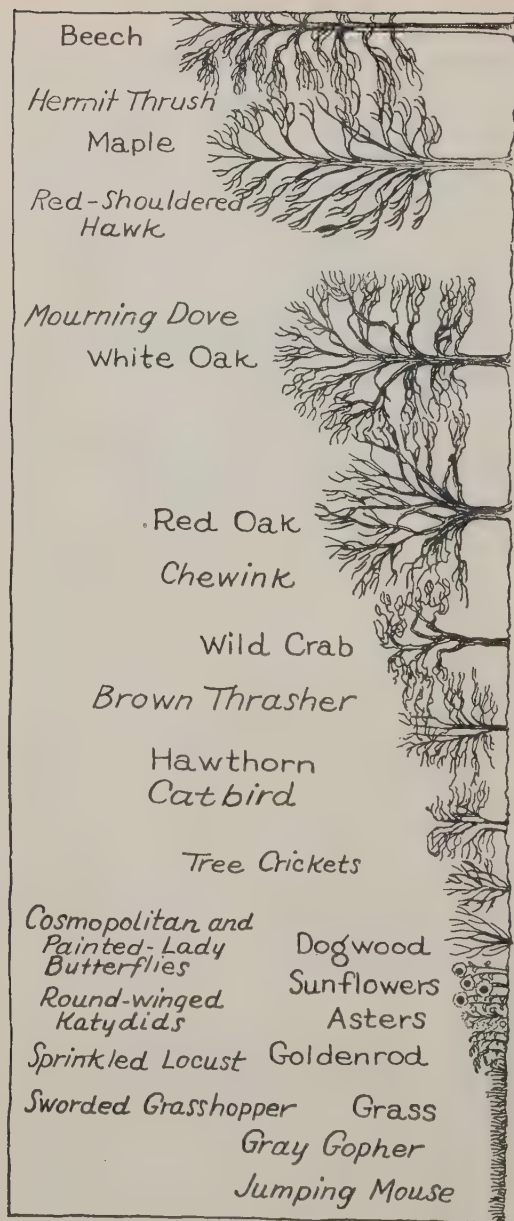
The male rosebreasted grosbeak is a striking bird though smaller than a robin. His head, back, and tail are black, his breast blood-red. There are large white spots on wings, rump, and tail. The female looks like a large sparrow. The bill of the bird, as the name indicates, is heavy and is used as a nutcracker to get the meat out of the seeds it feeds upon.

The chipping sparrow is a plain little bird with the characteristic striped gray and brown back of the sparrows and a bright chestnut crown. Its incessant note "Chip, chip," spoken while it scratches and feeds, gives it its name. The tree sparrow also has a reddish crown. It has white wing bars and one dark spot in the middle of its otherwise plain breast.

The indigo bunting is a small bird, smaller than the sparrow. The male is indigo blue all over, the female, brown, washed with blue. The color is so striking that it is not easily confused with any other bird. Its song is a complicated warble surprisingly loud for so small a bird.

LIFE ON THE FOREST MARGINS

Along the margins of such an oak-hickory forest, or of a beech-maple forest, where the forest joins the adjacent prairie, one finds another association of shrubs and trees and the animals that dwell among them. Here the wild crab and the hawthorn, or thorn apples, are the characteristic trees,



Forest Margin Showing Zoning of Plant and Animal Life from Prairie to Climax Forest

with the wild plum, now coming to be rather rare in most localities. The almost impenetrable thickets of these tangled trees make ideal nesting spots for such birds as the brown thrasher and the catbird. Both of these birds belong to the mocking-bird family. The brown thrasher is a slender brown bird some twelve inches in length; its breast and sides are mottled with dark spots. It looks somewhat like a thrush and is often improperly called the brown thrush, but it does not belong to the thrush family.

The catbird is a sleek, bluish-gray bird some ten inches in length. The crown of the head is marked with a very dark area. Both of these birds are good imitators of the songs of the other birds in their environment. The brown thrasher is the more able songster of the two. The catbird is very prone to emit its unmusical squawk, from which it gets its name of catbird, as one pushes his way into the thicket where its nest is located. In the fall of the year this hawthorn-brown thrasher zone is likely to be bordered with a gay garden of goldenrods and asters of many different sorts. The large red-purple New England aster with hairy stem, and a tiny white aster with the heads of bloom fairly covering the plant (*Aster vimineus*) are common. The prevalent sunflower is probably *Helianthus grosserulatus*. These late flowers attract to them the numerous insects that are still busy—the bees, flies, wasps, and species of beetles.

It is not to be expected that all of the plants and animals that have been described above will be encountered in any single trip to these forests and their bordering zones of hawthorns and crabs. One could profitably make several trips to these localities to identify the animals and plants encountered. Nor will it be supposed that there have been described all of the animals and plants that one will find in such locations. Only those that are the most conspicuous have been noted. Still, enough have been named to make several trips to these locations profitable to the student, and to set him on the road to learning something about the plants and animals of such societies.



The common sunflower (*Helianthus annuus*) and the New England aster (*Aster Novae-Angliae*) are found abundantly on the forest margins in the fall

We must return to these woods again in the spring when the ground is covered with the early spring flowers. The shade under these trees is so dense that many of the flowering plants spring up before the leaves are out, blossom, and begin to form their fruits. In the summertime, therefore, the flowering plants are not a conspicuous element on the ground in such forests.

A LITTLE JOURNEY TO THE PRAIRIE IN THE FALL

NEXT we shall make a little journey to the prairie. In contrast with the forest floor, it is ablaze with blossoms in the summer and fall. Here on the prairie there is no shade; plants can grow that require a long period of sunlight to develop and open their blossoms and mature their fruits. In the early days when the prairies covered entire states they were a sea of bloom as far as the eye could reach. Now,

of course, most of this land has become farm land. The prairie plants have been plowed under and it is only in occasional spots, odd corners on the farms, or along the right of ways of railroads that one finds the prairie plants in abundance.

Not all the prairies are alike. The typical prairie is an upland prairie with deep and rich soil, and prairies of this type are the most extensive. Then there is the wet prairie, not necessarily lowland, but if not, underlain with clay so that it retains the water well. There is another type of prairie in which the soil is relatively thin and is underlain with rock, usually limestone.

Nowhere better than in the typical upland prairie do we see the distribution of plants in time. We mean, by this, that there is a succession of plants coming into maturity from the early spring until late fall so that one must make a series of visits to the prairie to see in their glory all the plants of this association. Some plants come early, blossom and mature their fruits, then die down and almost disappear, while others come in and overtop them by their vigorous growth, these in turn to disappear before the oncoming plants of late summer and early fall. We shall begin here with the latter plants and visit the prairie again in the spring to see the earlier ones in the succession.

FALL PLANTS OF THE UPLAND PRAIRIE

By early September only a few of the blossom stalks of Culver's root will still be left. This is a plant that sends up a branching blossom stalk, the small white flowers on which are grouped in slender spikes. The leaves of the plant occur in circles about the stem, four to seven leaves in each circle or whorl. These leaves have flat short stems, are lance-shaped, sharply pointed, and finely toothed.

Probably every child knows the brown-eyed susans. The so-called flower is really a flower cluster, with a group of dark brown very small blossoms at the center and a number of

yellow blossoms sticking out around its margin. The former flowers in all the plants of this composite group are known as the disk flowers; the marginal ones, as the ray flowers. This brown-eyed susan is sometimes also referred to as the yellow daisy.

There is also found on the prairies a beautiful coneflower in which the disk flowers stand up in a more conical cluster, while the ray flowers are rose-colored or purple, sometimes shading into white. There are two of these purple cone-flowers that are common. In one the ray flowers stand out from the disk; in the other the ray flowers droop, giving the common name of the drooping purple coneflower. There are also cone-flowers with yellow ray flowers.

Among the most gorgeous of the prairie flowers in the late summer and early fall are the blazing stars. The flower cluster is a tall spike of heads of blossoms, the blossoms purple in color. A patch of these plants looks as if someone had stuck a lot of purple broomsticks into the ground. There are a number of species of this plant, but all look much alike; hence the description here given will apply to any of them. Their leaves are narrow and the margins are without indentations.

The rosinweed has a cluster of large leaves shaped like the head of a spear and these are thick and harsh to the touch. When the stem of the leaf is broken there flows out a sap that hardens in time to a rosin-like mass and children sometimes use this for gum and call the plant the "prairie gum weed." It is also known as the prairie dock. From the center of this clump of leaves there grows up a stem sometimes to a height of six or seven feet bearing a loose cluster of sunflower-like heads of bloom. Another closely related plant also known as the rosinweed, or better, the compass plant, is found on the prairie and looks much like the one already described except that its leaves are deeply cut and the lobes cut again, so that the whole leaf is somewhat fernlike in its appearance except that it is coarse and harsh, not delicate as are the fern leaves.

ANIMAL LIFE OF THE UPLAND PRAIRIE

The nests of the prairie ant, marked by large hills of materials which it excavates from below ground, are conspicuous. Naturally in a place where flowers are so abundant one would expect many insects. A host of butterflies are to be seen hovering over these plants, though few of them are confined to the prairie. Most of them make their way frequently into the adjacent forests and swamps.

The painted lady and the cosmopolitan frequently lay their eggs on the prairie thistle and their young feed upon it. This thistle is somewhat similar to the common bull thistle but the leaves are not so firm in texture; the spines upon it are rather weak and usually only a single very large head of pale purple blossoms crowns the plant. The larvae of these butterflies pull the leaves together and hold them in place with strands of silk and in this well-protected retreat feed and finally pupate, transforming to the adult butterflies.

Since the common field milkweed is often abundant on the prairie, the milkweed butterfly is also common. This plant however is found in many other localities and the butterfly is not confined at all to the prairie.

Bees, wasps, and flies of many species visit these prairie plants especially in the fall, as they are among the flowers that persist when most of the flowering plants have been killed by the early frosts. Feeding among the grasses of the prairie are many species of grasshoppers, and these species differ on the three types of prairies mentioned, but the distinguishing features are too detailed to describe here.

Earthworms are common in the rich prairie soil and their mounds of castings are easily observed. Here especially one finds the big night crawler, an earthworm that comes out of its burrows to feed at night. It is as large around as one's little finger and eight or ten inches in length. The star-nosed mole burrows in the soil for these earthworms and for insect larvae. It is similar to the common mole but more heavily built. Its front feet are strong and armed with powerful

claws. Its snout bears a fringed disk which gives it its name.

The ground squirrel, or striped gopher, the gray gopher, and the pocket gopher are common. These all carry great quantities of food in the loose skin of the cheeks and may be seen scurrying from their feeding ground to the nest holes to deposit these winter supplies, with cheeks bulging as if they were affected with a bad case of the mumps.

The little field mouse and the meadow mouse feed here on the prairie grasses.

This prairie is also the favorite nesting place and feeding grounds for many birds such as the bobolink, meadow lark, dickcissel, grasshopper sparrow, vesper sparrow, prairie horned lark, lark bunting, and prairie chicken. Of these birds, probably the meadow lark is best known. It is a bird some twelve inches in length with a yellow breast that is marked by a black crescent. The outer tail feathers are white so that they become a conspicuous mark when the animal takes to flight. It builds its nest on the ground and covers it with interlaced grasses so the nest is frequently at the end of quite a long grassy tunnel. The bobolink is known by its bubbling song quite as well as by its appearance. The bird is black and yellow with a conspicuous white patch at the base of the neck on the back. The dickcissel is somewhat sparrow-like in its appearance and about the size of a sparrow. Its back is sparrow-like but its breast is dull yellow. There are yellow lines on the head and a black spot on its throat.

The vesper sparrow is the only one of the sparrows that has the outer tail feathers white, forming a white V as it flies.

The grasshopper sparrow has a note much like the strident call of the grasshopper. It has the habit of running along the ground rather than taking to flight.

The prairie horned lark comes nearer to being the equivalent of the European lark than any other bird we have. It is about eight inches in length and is characterized by a little upturned group of feathers on either side of its head, these appearing like horns. The throat is yellow and the breast

is marked with a large black spot. It is a beautiful songster and has the habit of rising in ever-widening circles from the ground and singing its joyous notes as it rises. When almost out of sight it drops like a stone to the ground.

PLANTS AND ANIMALS OF THE OTHER PRAIRIES

As the prairie becomes drier the rattlesnake master comes to be a conspicuous plant. The leaves are swordlike and stand erect. The blossom stalk bears on its numerous branches many heads of white flowers. The leaves are not only slender and stiff, but bear along their edges sharp points somewhat like the leaf of the yucca that is found on the western deserts.

On the thin-soiled prairie, prairie clover and the lead plant are characteristic forms. The latter belongs to the pea family. The blossoms are pea-shaped and are purplish in color. The whole plant is covered with short white hairs that give it a luster somewhat like freshly cut lead.

The prairie clover belongs to the same family. The leaves are compound and the flowers rise in a dense cluster at the end of the stalk. The flower clusters are conical in shape, in one species white, in one rose-colored.

There is a little snake in the wet prairie that is quite characteristic. It is rather bright green above, pale greenish-white below. It is commonly known as the green snake. It usually is not over a foot in length and feeds chiefly on numerous insects.

In this same moist prairie one finds the holes dug by the chimney crayfish. These holes are surrounded by a chimney of clay soil that the crayfish has dug out in excavating its burrow. It digs down deep enough to have its well partly filled with water so it can live in a moist retreat from whence it comes out chiefly in the dusk of evening or early morning to feed. As you walk across the wet prairie among these burrows of the crayfish you hear them drop back from the top of their burrows into the water below, with a splash.

ADAPTATION OF PRAIRIE PLANTS AND ANIMALS TO THEIR ENVIRONMENT

There have been given now some of the characteristic animals and plants of these various prairies. One might spend a lifetime in the study of the inhabitants of these locations and then not know them all; but sufficient information has been given to help the student realize that there are both animals and plants that are characteristic of these locations. Plants and animals live in such situations—live, in fact, in all of these plant and animal societies—because they are adapted to the peculiar environmental conditions that surround them.

The prairie is a place of intense light and, in midsummer, of intense heat. The chief plants of these areas are the grasses and the closely related sedges. Nothing has been said concerning these plants, for they are numerous and difficult to distinguish, but they are eminently fitted for such locations. Their leaves are narrow and stand more or less erect, so they avoid the full glare of the noonday sun but catch the early morning and late afternoon light. There is a wild lettuce that grows on the prairie which has adapted itself to this intense light. The plant has a milky juice and the main stem of the plant is quite high. The leaves are deeply cut along their margins, and when in blossom the plant has a cluster of small yellow flowers. The plant is commonly known as the compass plant because its leaves stand out from the main stem of the plant and point in general north and south. Each leaf is turned on edge so that the broad part of the leaf is vertical. Thus it has the edge of the leaf turned to the noonday sun but catches the light of early morning and afternoon from east and west. One of the rosinweeds—the cut-leaved one—is also known as the compass plant because it has a similar habit.

You will recall that the rattlesnake master has sword-shaped leaves that stand upright and remind one of the leaves of the western desert yucca. So it escapes the full

glare of the sun. Some of these plants like the rosinweed have rather thick and glossy leaves. The thick skin of the leaf reflects the intense light and heat and protects the softer tissue on the inside of the leaf. The lead plant is covered with a dense coat of hair that similarly shields the working tissue of the leaf from the intense heat and also tends to prevent evaporation. The mullein, or velvet leaf, a common weed that frequently grows on the prairie, is similarly protected.

It makes an interesting study to try to see how these various plants that live in such associations do adjust themselves to the conditions in which they live. Transplant the ferns that we find growing in the dim light and moist atmosphere of the beech-maple forest to such a prairie location and they would probably shrivel and die. Take, in turn, some of these prairie plants like the rattlesnake master or the rosinweed into the intense shade of the forest and they would likely not survive. This does not necessarily mean that a plant is growing in those conditions in which it thrives best, but that it can grow under conditions which would be impossible for many of its competitors.

A LITTLE JOURNEY TO A DEVELOPING RAVINE

LET us go back now to our beech-maple forest, or to the oak-hickory forest, and find a place where a ravine is beginning to cut down below the general level of the forest floor, or find a similar ravine on the prairie and see what changes in animal and plant life are brought about by this process. In other words, we will make our next little journey to a ravine. A ravine, of course, is cut where some little stream flows with sufficient rapidity to wear away the soil or rock over which it is flowing. As a rule it forms in a clay soil or else in a rather soft rock. In light soil the sides of the little valley that the stream is cutting would wear down so fast that the valley would be rather broad and have gently



Photograph by Downing

Compare the relatively gently sloping sides of this developing clay ravine with those of the rock ravine (Glenwood Canyon) shown on page 42

sloping sides instead of being deep with steep sides. In a soft rock the stream can cut fast enough to wear out a rather deep gully before the rains and other weathering agencies have time to carry away the banks and make the valley a broad one. If we can, then, we will find such a ravine in clay soil and visit it first. Then later we will go to a rock ravine.

PLANTS AND ANIMALS CHANGE WITH CHANGING CONDITIONS

From the studies that we have already made it is beginning to be apparent that this grouping of plants and animals into societies is dependent on a number of factors, among the most important of which are light, heat, the amount of moisture present in the soil or in the air, and the character of the soil. The last named is important largely because it does determine the water content of the soil.

I have in mind a ravine that is being cut down through an oak-hickory forest, and as we start to clamber down the side of the ravine we notice that the oak trees are giving

place to water beech and hop hornbeam and basswoods. Toward the bottom of the ravine there are elms and white ash. Grapevines are festooning some of the trees. Not only the trees are changing but also the flowering plants. We find that hepatica, bloodroot, *Prenanthes*, and wood betony are growing on the slopes; and at the bottom of the ravine there are such plants as Queen Anne's lace and wild parsnip.

It is very evident that the developing ravine is changing the factors that cause this distribution of plants, and we can now see what some of these factors are. The bottom of such a ravine is supplied with abundant moisture because of the proximity of the little stream that is cutting it. As this stream wanders back and forth from side to side of the ravine it perhaps begins to build a miniature flood plain like that of the larger river, only on a small scale. The soil of this flood plain will be particularly rich since it will consist



Photograph by Downing

When the ravine cuts down through the oak-hickory forest we may find red cedar or other pioneer trees growing on the ravine edge

of rotting vegetable débris washed down from the higher areas. It also will be very fine soil and, so, capable of holding much moisture. The slopes of such a ravine will face the light at a different angle from the horizontal floor of the forest. If the stream is flowing east and west one of these slopes will face north and will be relatively cool and shady. If the stream is running north and south both slopes will be protected during part of the day from the intense light and heat. Evidently the edges of the ravine just where it drops off from the level of the forest will be very dry because the water will drain away from such a situation to the little valley below. Thus as the factors that condition the growth of plants are altered we should expect to find a change in the plants present and in the animals that feed upon them.

HOW A RAVINE IS FORMED

And now before we spend time in studying any further the plants and animals that are to be found in such ravines, we shall journey to the ravine to see what agents are producing it.

If you trace such a ravine up onto the high land where it begins, you will find that it starts as a little gully. The rains that fall upon this high land area seek some low spot as an outlet. They form a little stream running down this slight depression and begin to wear away the soil. This process of wearing away soil and rock is called erosion. As the drops of rain pelt down on the soil and run down the hillsides, they pick up small particles of soil and carry them along with them. During a shower you will see many muddy streams of water running down the street full of tiny particles of earth. So a little stream eats its way into the soil and forms a gully.

Other small streams join it on its way downhill, each one entering by the little gully that it has cut. As the stream grows larger, it is able to move larger pieces of dirt and stone. The more rapidly it runs the larger the bits of earth it can carry, so you will find that where the ground is steep and the little stream is running fast, it cuts away the soil rapidly.



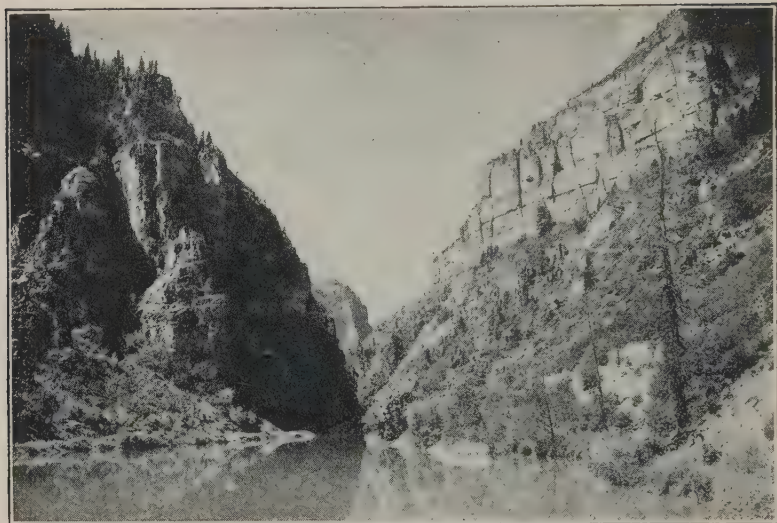
Courtesy, Chicago, Milwaukee & St. Paul Railway

Three forks, the source of the Missouri River. This great waterway was once only a ravine

Gradually, as you follow the little gully downstream, it becomes deeper and wider and at last large enough to be called a ravine. The sides of such a ravine as well as the sides of the little gully are steeply inclined, and when the rain falls and the waters run down this steep slope, they wear it away very speedily. Thus the ravine tends to widen out. By and by it becomes so wide that the stream is not large enough to occupy the entire bottom of the ravine. So the stream begins to wander back and forth from one side to the other. It is forced out of its straight course by little jutting points of unusually hard soil on one side and is thrown by the same obstacles to the other side of the valley. Then it strikes a similar hard spot on the opposite side and is thrown back again. For this reason we should find that a ravine is usually quite crooked.

As the stream grows larger, it becomes a tiny creek. Its narrow valley widens out. In such a valley we shall find a somewhat flat-bottomed area with the stream flowing through it in a crooked course. On either side will be the little hills, perhaps so steep as to be bluffs.

In the springtime, when melting snows are heavy and rains swell the little creek, it frequently overflows this



Photograph by F. E. Colburn

Courtesy, U. S. Forest Service

An excellent example of the rock ravine is Glenwood Canyon, Colorado

bottom land. The water over the flat land is not very deep and frequently is obstructed by grasses and bushes that are growing on the land. So the water cannot flow very rapidly and cannot carry much coarse dirt. The earth then tends to deposit on this bottom land.

When the stream cuts down to the level of the pond or lake or the larger stream into which it empties, the land over which it is flowing becomes more nearly level and the stream therefore flows very slowly, so slowly that it may deposit faster than it wears away the soil. In such cases, the soil is fine-grained, because the coarse material has already been deposited upstream. Frequently such river bottoms near the mouth of the stream have soil that is not only made up of fine particles, but soil that contains a great deal of decomposing vegetable matter, some of which was washed down from upstream, some of which is due to the decay of the plants that grow upon the soil.

The rock ravine is formed in very much the same way. Usually the rock ravine has steeper sides than the clay

ravine, because while the running stream can cut through the rock, the water that drips down the side of the ravine does not have force enough to wear away the rock particles rapidly. The stream therefore cuts into the rock faster than the other agents of erosion can wear down the steep rock banks. Sometimes in following down such a rock ravine, one comes to a waterfall. Some particularly hard layer of rock resists the wearing action of the stream. So the water goes tearing over the edge of this layer and as it falls on the softer rock below, it wears it away rapidly. Gradually the stream undermines the hard mass of rock, which falls into the stream to be pounded up in time by the water into small bits that the stream can carry on down the canyon. Thus the waterfall gradually moves farther up the canyon. Smaller streams that are tributary to the main stream cut their own little canyons that branch off from the main canyon.

OTHER AGENTS OF EROSION

There is another agent of erosion that is active in such a rock canyon, in the winter. The little cracks and crevices of the rock fill up with water and then in a cold spell this water freezes. Now when water changes to ice, it must expand and so the little crack or crevice is made larger. When this process is often repeated bits of the rock or even large fragments of it will be heaved off the side of the canyon, into the stream below to be gradually pounded up into the fine rock particles that we call soil.

The roots of plants growing on the rock walls of such a canyon penetrate little crevices and as the roots grow larger, they also force the rock apart. So in time chunks of the rock will fall away, sometimes carrying the shrub or tree with them. Thus growing plants are also agents of erosion.

Strong winds, especially when they are loaded with particles of dirt, act as agents to wear away the rock and soil. Sometimes one will see even in very dry regions, where the erosion cannot be due to water, rocks whose surfaces are

worn smooth by such winds that carry quantities of sand. The winds also transport dirt and in regions where they blow chiefly in one direction, they come to be important agents in drifting the soil over long distances.

If one walks along the shore of a large lake or the shore of the ocean, he will see that the waves and water currents are also important agents in changing the shape of the land. In places where the waves break along a rocky shore, or at the base of clay cliffs, the shore is constantly being worn away by such wave action. The waves strike with very great force. The air in the cracks and crevices of the rock is compressed as the wave strikes, so that the rock is broken. The force of such compression at times of heavy storms is as much as two tons to the square inch. When the rock is thus broken into chunks, the waves use this broken material, hurling it against the shore, not only pounding the cliffs with it, but at the same time pulverizing these fragments. Waves, therefore, are a powerful agent of erosion.

Sometimes, however, the waves of the lake or ocean build up land instead of tearing it down. The waves bring in with them sand and dirt as they roll up on a low shore and they leave this sand and dirt on the shore as they retreat. So one frequently finds a sand bar appearing offshore. Gradually this rises as the waves deposit more sand upon it, until it begins to appear above the surface of the water. Then it acts as a barrier to check the speed of the waves. As they wash over it they let fall into the shallow water behind it the sand which they carry. In this way the earth is gradually built up back of the bar until the lagoon behind the bar is completely filled in. By this process the lake or ocean forces itself to retreat as it builds land.

A SPRING JOURNEY TO THE FOREST

IN THE early spring let us take a little journey again to the beech-maple forest or to the oak-hickory forest. We shall now find the floor of such a forest brilliant with the

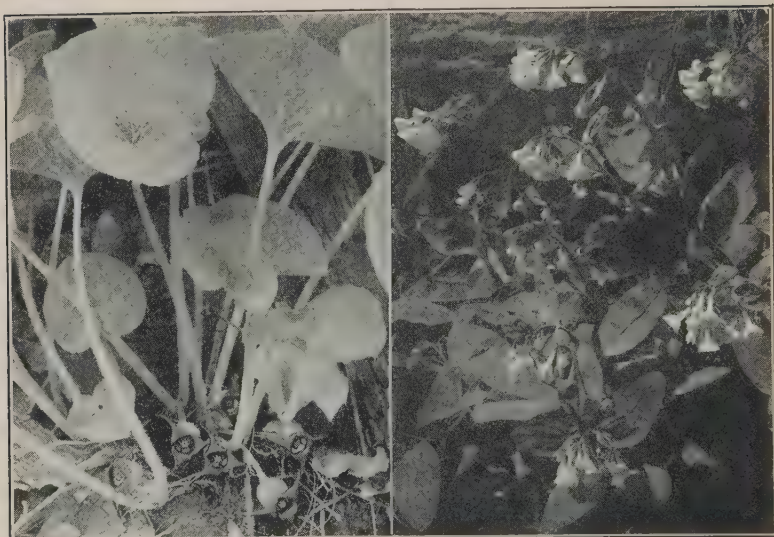
flowers of many early plants. These plants must spring up quickly, blossom, and set their fruits before the trees are in full leaf, otherwise they do not have enough sunlight to do this work, since the shade, especially in the beech-maple forest, is very dense. These plants do not all come at once. Some of them are very early and blossom in the first days of spring; others wait a bit; and still others blossom in the early summer.

HOW TO KNOW SOME SPRING FLOWERS

Among the first of the spring blossoms we may expect the spring beauty, the spring cress, toothwort, hepatica, bloodroot, and adder's tongue. A little later will come the red and white trillium, Dutchman's-breeches, jack-in-the-pulpit and the green dragon, both the false and the true Solomon's seal, and possibly ginseng, if it has not been all rooted up because its tuber is valuable. There will also be the woodland phlox, lungwort, probably wild ginger, sweet cicely, waterleaf and columbine, a variety of violets, and possibly some of the orchids.

A great many of these plants that do come into blossom in the early spring have underground stems that are loaded with food materials. This food the plant uses to make its rapid growth in the spring, so as to produce its blossoms and fruits early. Then it spends the rest of the season in restocking these underground parts with food for the next year's rapid growth.

Toothwort is a plant with a cluster of white flowers, each flower having four white petals arranged in the form of a cross. There are six stamens, four of which are longer than the other two. The leaf is a much-dissected, somewhat fern-like leaf. Hepatica has a three-lobed leaf that grows on a short stem. The flowers are purple or rosy. Bloodroot is a pure white blossom. The leaf is large and somewhat semi-circular. The stem when broken gives a blood-red sap. The leaf of the adder's tongue (sometimes called dogtooth



Wild ginger (*Asarum canadense*) and Virginia cowslip, or lungwort (*Mertensia virginiana*) are among the spring flowers to be found in the forest

violet) is lance-shaped and grows directly from the ground with scarcely any stem. The single blossom hangs down from the upper end of the rather long and slender stem and is somewhat lily-like in appearance, yellow or white.

Trillium has a large three-parted leaf. In the red trillium the blossom comes from the center of the leaf clusters and has red petals that stand up while the green sepals are turned back. There are three petals and three sepals. The flower of white trillium is quite large and consists of three spreading white petals alternating with three green sepals. Dutchman's-breeches has a finely divided, somewhat fernlike leaf and the white blossoms are shaped much like a pair of breeches.

The leaf of jack-in-the-pulpit is large and consists of three parts. The plant gets its name from the fact that the inconspicuous blossoms are borne on a green, somewhat fleshy stalk that is enclosed and partly covered by a striped green leaflike structure. This is the pulpit and Jack is the green stalk at its center. Jack and his pulpit are somewhat like the

central stalk of the calla lily and the white leaflike structure that encloses it. The green dragon is quite similar but the structure at the center is a long slender tapering green stalk. Solomon's seal has lance-shaped alternate leaves on a slender stalk. In the true Solomon's seal a pair of blossoms hang on slender stems from the point where the leaf joins the main stalk. The false Solomon's seal has a cluster of greenish-white blossoms at the end of the stem.

Wild ginger is a low-growing plant with semicircular leaves and an underground stem which is close to the surface and is gingery both to taste and smell. Sweet cicely has a finely divided leaf with the odor of licorice when it is crushed. The much-dissected leaf of the waterleaf is blotched with light green on a dark green background. The flowers are small greenish-white and grow in clusters at the end of the flower stem. Lungwort is a low-growing plant with clusters of bell-shaped deep blue blossoms.

A LITTLE JOURNEY TO THE PRAIRIE IN SPRING

IF NOW in the spring we make another little journey to the prairie, we shall find quite a different set of plants. Not only is it interesting to see that the plants of the prairie are different, but it is worth while to make a number of visits to such a locality through spring and summer to see what plants are coming early, which ones are summer plants, and which ones appear only in late summer or early fall. If you visit a rather wet prairie, you will probably find in the spring a number of plants that appear somewhat like grasses, but whose stems are triangular instead of round. These are the sedges. Along with these will be growing some little rushes, the stems of which are round like the stems of grasses. They are not jointed, however, nor are they hollow, but the center of the stem is filled with a spongy pith. A little later, as the ground dries out somewhat, the common June grass will

appear. Probably timothy grass and squirrel-tail grass will also be seen.

The fruits of squirrel-tail grasses each bear a long spine, so that the seed-bearing stems are topped with a bushy mass something like a squirrel's tail. The seed-bearing stalks of timothy grass are topped by a long slender cylinder, made of the close-set seeds. In June grass the fruit-bearing stalk branches repeatedly and at the end of each branch is one of the seedlike fruits. The whole mass has an open and feathery appearance.

SOME SUMMER FLOWERS OF THE PRAIRIE

Conspicuous flowering plants are rather late. Probably it will be nearly the first of June when golden old man comes into blossom. About the same time or somewhat later water hyacinths and violets appear. You may find a few of the dainty little white violets. A deep blue violet with heart-shaped leaves is common, but most conspicuous of all is a pale violet, whose leaves are like a hand with very many fingers. It is commonly called the bird's-foot violet. Now, the spiderwort, shooting stars, and daisy fleabane will also be in blossom. A little later, the false dandelion and the meadow garlic are common. By late June the wild onion is appearing and a few blossoms of brown-eyed susan will begin to appear. These will be increasingly abundant. Low spurge, three-seeded mercury, and water hemlock are appearing by midsummer. The great leaves of the rosinweed are conspicuous. New sedges are replacing those of the spring. The barnyard grass is coming in, in place of the June grass and the squirrel-tail. And then appears that succession of forms that we have already studied in the prairie in the fall.

Spiderwort has somewhat grasslike leaves, clusters of blue flowers, and the stem and leaves when broken, give out a slimy sap.

The leaves of shooting stars grow in clusters from the center of which comes up the stalk that bears the flowers.



Above, left to right, are shown the rattlesnake root (*Nabalus crepidineus*) and the water hemlock or musquash root (*Cicuta maculata*). Below are the spiderwort (*Tradescantia Virginiana*) and the blunt broom sedge (*Carex tribuloides*). In the center is the Philadelphia fleabane (*Erigeron Philadelphicus*)

These flowers have five pink petals that curve back. In the midst of them is a group of five stamens from which sticks out the pistil. These parts are so closely appressed that the blossom looks as if it were beaked. It hangs with the pistil and stamens down. False dandelion looks somewhat like the ordinary dandelion, but all of the tiny blossoms that make up the blossom cluster are strap-shaped like the ray flowers of the ordinary dandelion. Meadow garlic and wild onion are readily known by the odor of the leaves and bulbs.

Water hemlock belongs to a group of plants in which the blossoms are grouped in little clusters, the stem of each blossom coming out from a common point like the ribs on an umbrella. Usually these small clusters are borne on stems that similarly come out from a common point. The plants are known as umbellifers, or Umbelliferae. Water hemlock has a main stem that is streaked with purple; the flower cluster is white.

A number of these Umbelliferae that are easily confused may here be distinguished. The poison hemlock has a smooth yellow stem that is spotted with purple. At the base of each stalk there is an extended leaflike structure that clasps the stem.

The wild and the meadow parsnip and the cow parsnip are somewhat alike. The wild parsnip usually grows in prairies, the meadow parsnip in meadows, and the cow parsnip in wet ground. The flowers of the wild parsnip and meadow parsnip are yellow. Those of the cow parsnip are white. The meadow parsnip has a smooth stem, but the wild parsnip and the cow parsnip have deeply grooved stems.

The wild carrot or Queen Anne's lace has a cluster of white blossoms sometimes tinged with yellow or with rose. The cluster inrolls so that it has something of the form of a bird's nest, and the plant is sometimes called bird's nest. It is common in poor soil. The stem is rough with hairy bristles.

Angelica grows in wet soils. The stem is purple and the odor is very pleasant. The leaflike structure at the base of the leaf stalk encloses the stem.

No attempt has been made to name all of the plants that would appear in such a succession. Enough has been said to make it clear that there is such a succession. Plants are distributed in time as well as in space, so that even in the same locality, like this spot on the prairie, we shall not expect to find the same things at all seasons of the year.

It would be very interesting to select some convenient spot, either in the woods, swamp, or prairie, or just a weedy lot right in the city and keep a record of the plants that appear from early spring until late fall.

A LITTLE JOURNEY TO THE RAVINE IN SPRING

LET us make another journey now in the spring to the ravine in the clay soil and to the rock ravine to observe more carefully the plants and animals to be found.

PLANT LIFE ALONG THE CLAY RAVINE

On the edge of the hills that face the ravine where the soil is dry, we shall probably find black oaks growing instead of the red and white oaks. When the ravine cuts down through the oak-hickory forest we may even find growing on the ravine edge the white pine, the tall juniper or the red cedar, as it is commonly called, and the spreading juniper. Probably there will also be some of the poplars like the cottonwood or the aspen; and such shrubs as the red-osiered dogwood and the staghorn sumac. Some of these same trees and shrubs may be found on the sides of the ravine. These steep sides also are dry because the water runs off rapidly from them. Here, too, we are likely to find patches of hairy cap moss and the field horsetail, also known as scouring rush or joint grass. Farther down the slopes of the ravine will be such shrubs and small trees as the chokecherry, pin cherry, ninebark, gooseberry, and possibly the blueberry or huckleberry. Columbine, bluebells, wild sarsaparilla, and the rattlesnake-

root (*Prenanthes alba*) are among the common herbaceous plants. Still deeper in the ravine where it is shadier and moister, some of the ferns will be found such as the cinnamon and interrupted ferns.

Wild sarsaparilla has two or three compound leaves, the leaflets radiating from the center, growing up from a single spot. From the stem comes the stalk that bears the spherical cluster of greenish blossoms. The underground stem has an odor and taste similar to that of root beer.

Rattlesnake-root is a plant with very variable leaves. Scarcely two on the same plant will be of the same shape. In general they are shaped like an arrowhead, but the margins will be variably cut and indented. The yellow flowers are borne in a loose terminal cluster.

In spring the cinnamon and interrupted ferns bear conspicuous spore clusters. The stems and the leaves of the former are covered with cinnamon-colored scales. The spores are borne on one stalk that is just a branching mass of spore



Photograph by Downing

Edge of a flood plain, showing marsh marigolds



Photograph by Downing

Blue flag growing along the stream margin on a small flood plain

cases. In the interrupted fern, some of the leaflets, about in the middle of the leaf, lose their leaflike character and become a mass of spore cases.

PLANT AND ANIMAL LIFE OF THE FLOOD PLAIN

As we follow down the ravine until it broadens out to give us a flood plain in the little valley, we find some characteristic trees such as the white ash, the American elm, soft maple, sycamore, and, if we are not too far north, the Kentucky coffee tree. Characteristic small trees are the hawthorn, the chokecherry, the wild crab, and the hop tree. Over many of these low trees will grow such characteristic vines as moon-seed, bittersweet, honeysuckle, poison ivy, Virginia creeper, and grapevines, particularly the wolf grape. The shrubs that one will commonly find are the prickly ash, nannyberry, bladder nut, elderberry, wahoo or burning bush, and, in the wet areas, buttonbush.

The hop tree is a low tree or shrub with a compound leaf of three leaflets. The fruits are borne in large clusters looking something like hops, the seed encircled by a thin wafer-like fringe. Moonseed is a vine with leaves shaped something like the wild grape. The fruits are somewhat beanlike and



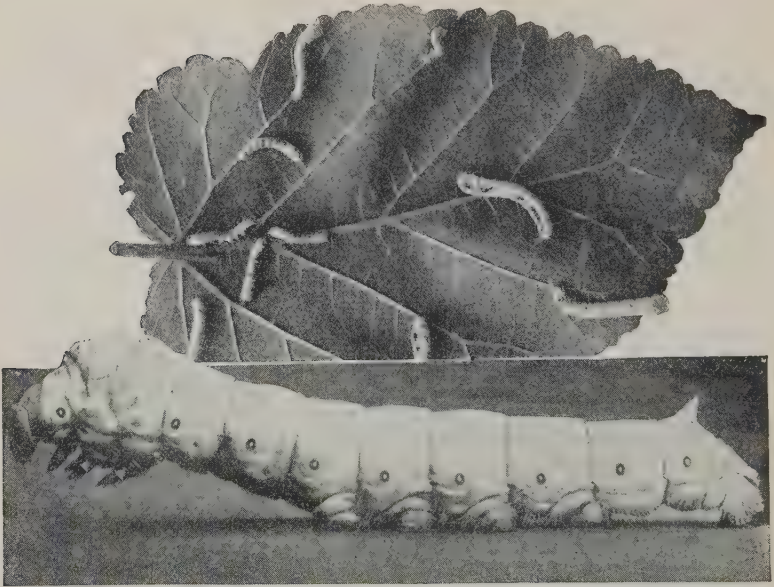
At the left is the fruit of the blue cohosh (*Caulophyllum thalictroides*); at the right, the fringed loosestrife (*Steironema ciliata*)

glistening white. Bittersweet is probably familiar to most people in the autumn with the scarlet fruits as big as the end of your little finger, surrounded by the recurved orange scale. In the fall, bladder nut bears clusters of inflated pods, the seeds of which rattle like peas in a dry bladder. The buttonbush has branches that bend at sharp angles, like the arm at the elbow. It is sometimes known as elbow bush. The white blossoms grow in spherical clusters an inch or so in diameter, looking like large round buttons.

Now in the spring this flood plain with its rich soil will have an abundance of flowering plants such as sweet cicely, trillium, waterleaf, wild ginger, fringed loosestrife, blue cohosh, and meadow rue, together with some others that we have already noted in the beech-maple forest. Here, as there, there is abundant moisture in the soil and fairly deep shade under the great trees. Here, in the very early spring, one will



Above, left to right, are the berries of the bittersweet (*Celastris scandens*) and the blossoms of the wild crab apple (*Pyrus coronaria*). In the circle are the blossoms of the bladder nut (*Staphylea trifolia*). Below are the fruit of the bladder nut and the fruit of the hop tree, or wafer ash (*Ptelea trifoliata*)



Courtesy, The Corticelli Silk Company

Above are shown silkworms feeding on a mulberry leaf. Below is the American silkworm (greatly enlarged)

find the skunk cabbage about the first plant that blooms.

Skunk cabbage has very large leaves that come up very early in the spring, but even before the leaves appear there grows up a green leaflike structure as large as one's fist or larger, looking like a partly rolled leaf. In the center of this is a green club-shaped stalk as big as one's finger, at the base of which are inconspicuous greenish flowers. Both the flowers and the leaves give off a disagreeable odor, hence the name.

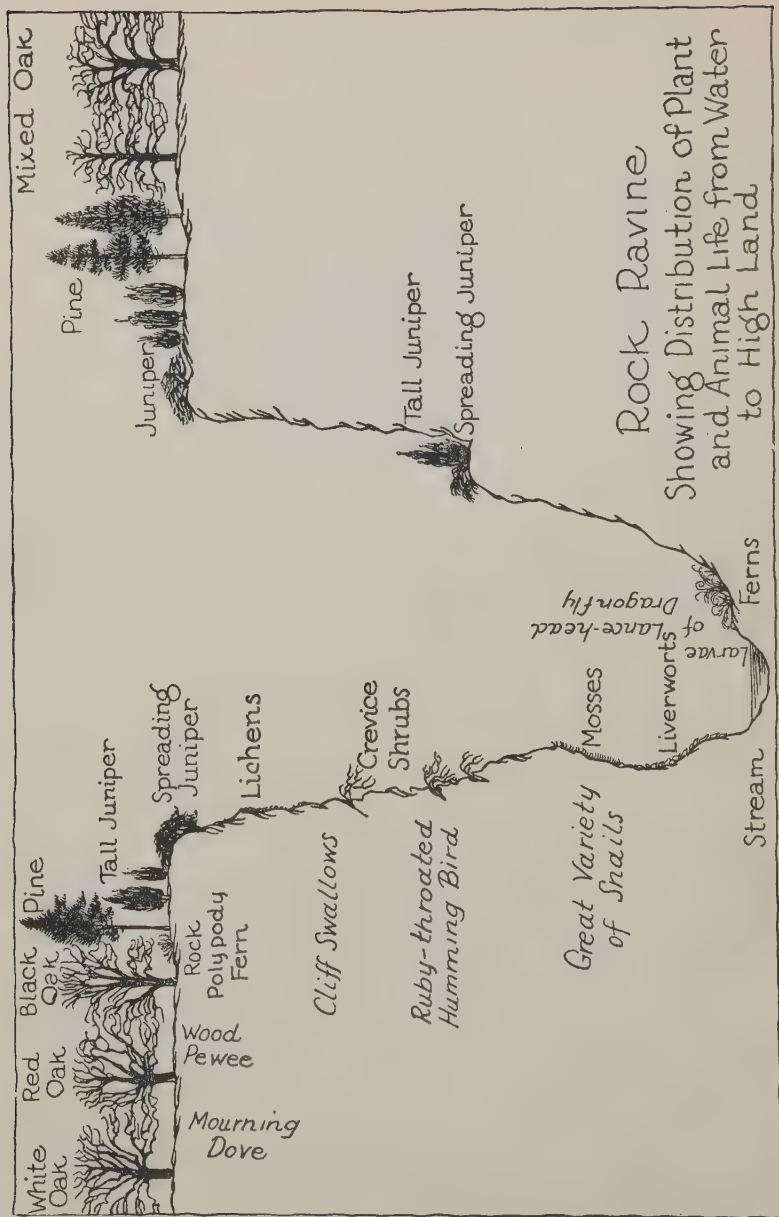
The plant and animal life is not the same even all over this flood plain. On the margin of the river, one finds such insects as the toad bug and the hooded grouse locust, while the little spotted and solitary sandpipers run along the shore probing the mud with their long bills for insect larvae or other food. Just back from the water margin the giant ragweed grows abundantly, and here one will find a very thin-shelled snail (*Omphalina*) crawling over the ground. Back still farther

come willows, the black and long-leaved willows being the commonest ones. When these willows are in blossom in the spring, many flies, bees, and beetles are attracted to the catkins to feed on the pollen. On the willows in midsummer, one is likely to find also larvae of some of the large moths like the American silkworm moth and the luna moth.

SOME PLANTS AND ANIMALS OF THE ROCK RAVINE

Since the rock ravine is usually quite narrow, its bottom is in deep shade much of the time and the air is cool and moist. The rock sides of the ravine frequently drip with moisture. Growing in the cracks and crevices one finds some ferns like the bladder fern, fragile fern, and cliff brake, and possibly the walking fern. In the bladder fern the spore cases are covered by a thin membrane that is puffed out like a bladder. These are found on the back of the fern leaf. The fragile fern has its spore cases covered by a somewhat similar thin membrane, but this is shaped like a pointed leaf. The walking fern has leaves with long tapering tips. The leaf is not at all fernlike but is shaped somewhat like a spearhead. When the leaf tip lies on the ground, roots strike into the soil and a new little plant is produced. The cliff brake is readily told by its dark purple stems. Mosses grow luxuriantly on the rock sides. Frequently large areas of the rock are plastered with the liverworts, plants without stems whose leafy bodies spread over the rocks, hanging on by rootlike holdfasts.

These moist ravines are favorite living places for many snails, similar to those that we have already seen in the cool moist beech-maple forest. The white-lipped snail is common. Another very much like it has a deep hole on the side of the shell opposite the tip of the spire. Still another has this hole about half covered. Some pupils might enjoy making a collection of the snail shells of the region. In most locations where these animals are to be found, it is easy to discover



Rock Ravine Showing Distribution of Plant and Animal Life from Water to High Land

empty shells that may be taken for the collection. In woods, ravines, ponds, and streams one can find from fifty to one hundred different kinds of snails. In such a hunt for snail shells, one will find many of them with a large hole broken through the shell. These snails are the favorite food of such animals as the squirrels, who break the shells and in this way extract the body of the animal.

In the steep banks of the clay ravines, one may find the nest holes of kingfishers and bank swallows; and in the rock ravines, rough-winged swallows may be found nesting in the holes of the rock.

A LITTLE FISHING TRIP TO THE BROOK

NOW let us prepare to go fishing in the stream itself, whose course we have been following down through the ravine and its broadening river valley. There are many interesting plants and animals living in its course. To capture some of the creatures we shall need a net, for the handle of which we shall use an old broomstick. Cut a piece of very stiff wire, about four feet long. The wire should be considerably heavier than telephone wire, perhaps $\frac{1}{8}$ or $\frac{3}{16}$ of an inch thick. Bend this into a hoop and then bend the ends out from the circumference of the hoop so that they can be bound onto the end of the broom handle with heavy twine or fine wire. The net is to be a bag about a foot in diameter and 30 inches deep. It can be made of cheesecloth or better still, because it is stronger, of bobbinet. Sew the mouth of this net onto the wire hoop and then sew on some broad tape or a strip of strong cloth so that the edge of the net will not wear.

Take with you on your fishing trip three or four pint fruit jars, so that you can bring back some of the animals that are found and watch them more carefully at home. Many of them will live quite comfortably in your aquarium.

SMALL ANIMAL LIFE OF THE STREAM

Suppose we start our fishing in a little brook or creek where the water is running quite rapidly over its pebbly bottom. Off with shoes and stockings and wade into the stream! Roll up your sleeves, way to the shoulders. Now let us pull out some of the rocks and stones on the bottom of the stream and see what we shall find. Probably one of the first things that we will see will be some snails clinging to these rocks. One of them has a rather short twisted shell and lives in great numbers on these submerged stones in the rapid water (*Goniobasis*). Another one (*Pleurocera*) has a heavier shell, with a long rather smooth spire. Still another which you will hardly recognize as a snail at first is attached very firmly to the rock and has the shape of a peaked hat, something like a flattened liberty cap. It is small, not larger around than the end of a pencil.

Attached to these stones you will find some curious little



Every brook is a laboratory filled with interest for the children who are taught to know and appreciate Mother Nature



Dr. Downing with dip net getting subjects from the brook for study

tubes made of bits of stone fastened together. These will be perhaps a half-inch long and as large around as a pencil at their wider end. This wider end faces upstream and is covered with a fine meshed net. Living at one side of this tube, close to the rock and imbedded in a part of the tube, is the little larva of the caddis fly that builds the tube. As the water runs through the tube, like water poured through a funnel, tiny living things that are in the water are caught on the net. Every few minutes the little larva sticks its head out and if it finds fit material on its net, it will proceed to make a meal. There is another caddis fly which lives in a tube made of bits of stone, but in this case the tube is coiled like that of a snail shell. The caddis flies are gauzy-winged insects that flit about over the stream or along its banks.

There are a number of animals that live under these stones. They scamper away when the stone is moved, but you can frequently catch them by putting your net into the water so that the rim rests on the bottom, just below the stone you are going to move. Turn the mouth of the net upstream and then move the stone. The rapid current will carry the animals into the net. Or you can back upstream, holding the net handle in your hands with the mouth of the net upstream and its rim pretty close to the bottom. Then you can move the stones with your foot, and after you have moved several take up your net to find out whether you have caught anything.

In this way you will be likely to catch the larvae of May flies, stone flies, dragon flies, damsel flies, and probably some of the fish that live in these rapid waters. The stone fly larvae have a pair of long feelers at the hind end of the body, and feathery tufts of gills at the point where the legs join the body. Damsel fly larvae have three leaflike breathing plates at the hind end of the body. May fly larvae have platelike gills all along the sides of the abdomen and three long feelers at the hind end of the body. The dragon fly larvae have very large eyes. The body is heavy, somewhat flattened, almost turtle-like, and frequently colored dark like the stones or mud on the bottom.

LITTLE JOHNNY DARTER AND THE OTHER SMALL FISHES

The fish that you will most often catch will probably be the little Johnny darter. The rainbow darter, the golden shiner, and the red-bellied dace are also common. The fins of the darters are quite large, especially the pair on the underside of the body just back of the head. Johnny darter has big eyes that stand up above the surface of the head. The rainbow darter, especially in the spring, is brilliantly colored with a variety of bright colors. The red-bellied dace has a salmon-colored streak down each side, bordered by black,

and its belly is bright red. The golden shiner has a lustrous body, with a distinct golden color.

It usually is a great surprise to find such brilliantly colored fish in our little streams, for one thinks of such animals as belonging to the tropical seas.

The fish described are all small, hardly a finger's length, and since they live in such rapid water, it is a bit difficult to keep them in an aquarium because they need an abundance of air. If you do try it, put only a single fish in a jar like that we use for goldfish. Do not fill the jar with water, but have the water rather shallow and in it have a good deal of water plant. Frequently you will find in the streams where the fish are caught, a plant growing under water in rather long ropes. It has leaves that are very finely cut. This is a good plant to put into the aquarium with the fish.

Such fish as the red-bellied dace and the rainbow darter are much more brilliantly colored in the spring than at any other time of the year, for this is their breeding season. The males, too, are much more brilliantly colored than the females. Apparently at the mating season the male wears his most attractive coloring.

Sometimes in quiet pools of these streams where the bottom is covered with rather fine gravel or coarse sand, you will see Johnny darter busy making his nest. The fish lies on the bottom, holding himself in place with the big fins just back of his head, and then by moving his tail back and forth he sweeps out a little hole in the sand or gravel. Here the female lays the eggs. These are tiny, not larger than the head of a small pin and are slightly yellow, almost like little amber beads. They are held in among the bits of sand or gravel and the male and female fish apparently take turns in guarding the nest so that the eggs may not be eaten by other fish or by the insect larvae that are prowling around after just such choice bits of food. It takes only a few days for the sun's heat in the shallow water to hatch the eggs. The little fish carries around with it much of the egg which it gradually absorbs for food. Even after the young fish are



Across Valley of a Little Creek
Showing Zoning of Plant and Animal Life

large enough to feed for themselves, they are guarded for some time by mother and father fish.

Johnny darters will live in the aquarium very comfortably. Usually there is enough food material on the water weeds that are put into the aquarium to furnish the pair with food. If the aquarium has a sandy bottom they will even breed in confinement.

MAKING AN AQUARIUM FOR THE CATCH

It is quite possible for anyone to make an aquarium for himself. Unless he is quite handy with tools, perhaps it would be best to get the frame of the aquarium made by a tinner. The tinner will cut some long strips of tin an inch wide and then bend them all along the middle of the strip so as to make a strip consisting of two one-half-inch wide parts that stand at right angles to each other. These long strips can now be bent and soldered together so as to form a frame like the edges of the box, say 12 inches long, 8 inches wide, and 6 inches deep. With a glass cutter, which can be bought at the hardware store for 10 cents or 15 cents, any child can cut glass for the bottom, sides, and ends of this aquarium.

To cut the glass, lay an old window pane or window glass that is bought from the paint shop on the table. Lay a ruler on the glass along the line where you are going to make the cut. Hold the glass cutter in your hand as you would a pencil, and with it make a scratch the full length of the glass, guiding the glass cutter along the edge of the ruler. You will need to press the little wheel of the glass cutter firmly on the glass and hold it so you can hear it scratch the glass. If you do not hear it scratch the glass at once, change the angle at which it is held a little bit until the cutting edge of the wheel does take hold of the glass. Make a single scratch all the way across the glass. Now hold the edge of the glass in both hands with your thumbs on the upper sides of the glass, one on each side of the scratch and your bent first fingers on the

underside of the glass, one on each side of the scratch. Then try to break the glass by pressing up with your fingers. The glass will readily break the full length right along the scratch.

To fasten the piece of glass into the frame, a cement can be made. At the paint shop or hardware store buy 8 ounces of whiting, 1 ounce of red lead, 1 ounce of litharge, and about 4 ounces of raw oil. With an old kitchen knife or, better still, a putty knife, mix the three dry powders together. This can be done on a smooth board or on a piece of glass. With your knife make a hole in the middle of the pile and pour in some of the oil. Mix the powder into the oil. Continue this process until the powder is all moistened with the oil. Do not put in more oil than is absolutely necessary. You will now have a mixture that is about the consistency of putty. This can be taken in the hand and worked as you would work putty. Keep your hand dusted with some of the dry powder saved for that purpose. Cut off little pieces of cement with your knife and pile these up so as to make a continuous rim of the cement along the edge of the bottom glass. Now turn this glass, putty down, and press it into the bottom of the frame. Take off the excess cement that squeezes out with your knife. Similarly, set the sides and ends of the aquarium. Then roll out pieces of the cement between the palms of the hands into small ropes and press these ropes into the angles where sides and bottom join on the inside of the aquarium. This can be done with the fingers. Let the aquarium stand now for a couple of days. If these ropes do not stay in place, but run down, the cement was not thick enough and more of the dry powder should be worked into it so the ropes will stay in the angles. The aquarium can be used before the cement has hardened, as it will harden under water.

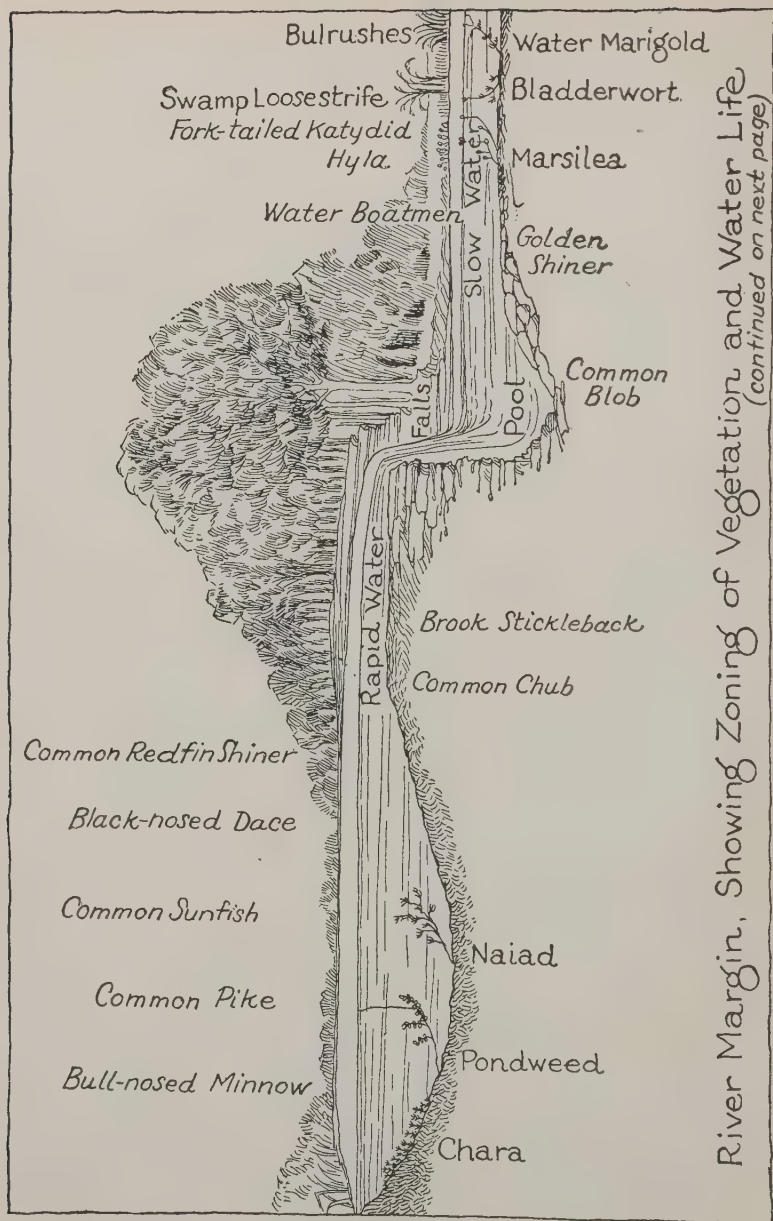
ANIMALS FOUND FARTHER DOWNSTREAM

As we go farther downstream where the little creek becomes good-sized, and the water is less rapid, we shall begin to find additions to the fish population found in the smaller

brooks. The black bullhead, the top minnow, the chub, and the shiner begin to appear. The sucker with its long snout that fits it for feeding on the bottom of the stream puts in its appearance. The fan-tailed darter replaces the rainbow darter and in the deeper pools, especially if they have gravelly bottoms, one may catch the rock bass, black bass, and the white bass or white crappie. Since these fish are likely to lie in the deeper water and are not easily caught with our net, we shall go and fish in the shallow water along the margin of the stream. In the quiet pools in such a location one will find crayfish in abundance.

You will remember that we have already seen the burrowing crayfish on the wet prairie. Another crayfish we have probably found hiding under the stones in the little brook. It will probably be a third species that we shall find in these pools along the margin of the stream. On the surface of such pools, there will probably be seen water striders and whirligig beetles. The latter, a small black shiny insect, moves over the surface of the water in erratic curves. The water striders are slender-bodied insects with long legs, and their feet are furnished with hairs. Thus they are able to walk on the water as a man using snowshoes can walk on the snow.

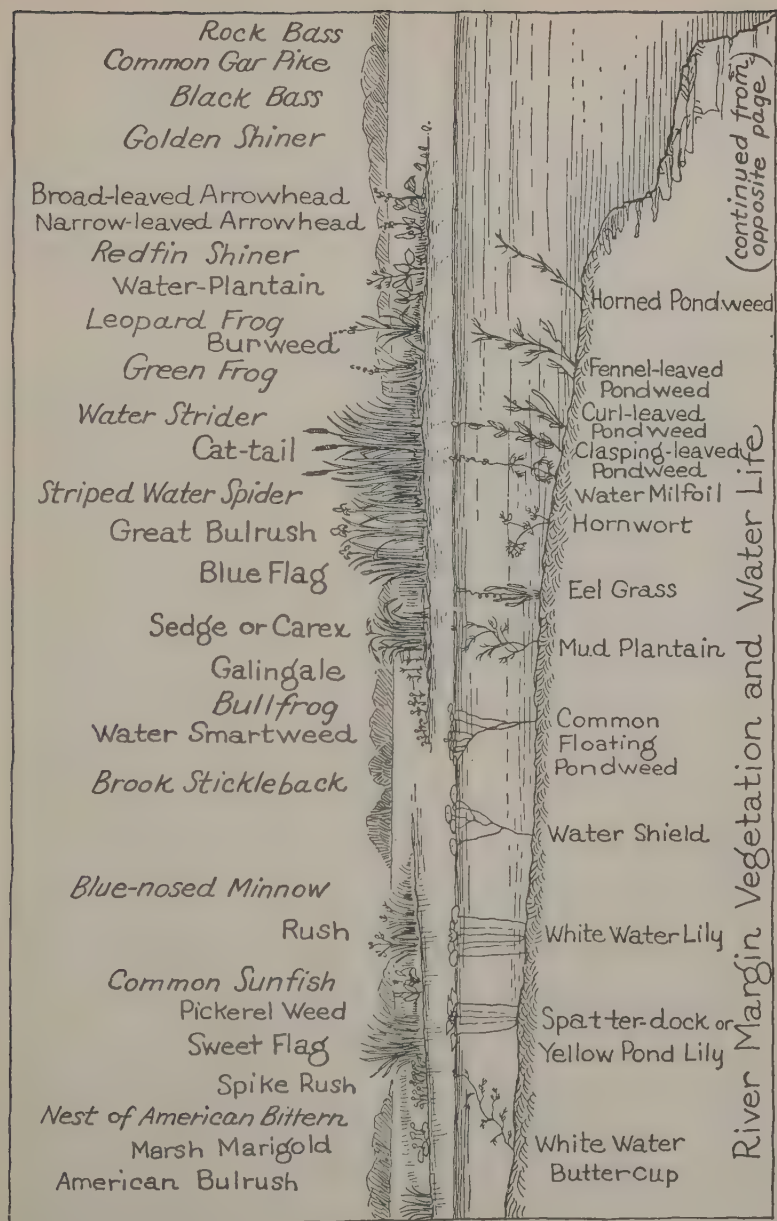
Along the banks of the stream one will probably find thrown up by the spring freshets empty shells of some of the clams. If one wades out into the stream and feels down in the sandy or muddy bottom, he probably will find such clams alive. The species of clams that are to be found vary according to the size of the stream and the character of the bottom. Different kinds will be found in the sand than in the mud. There are so many different species that it would be impossible to describe them all. They are particularly abundant in the Mississippi River and its tributaries. The kinds increase the farther south one goes. It will be an interesting task for some pupil to collect the various kinds of shells. Along some of the streams there are piles of these shells that have been thrown out by men trying to find pearls. These fresh-water clams do produce such pearls.



River Margin, Showing Zoning of Vegetation and Water Life
(continued on next page)

© Drawn especially for THE CLASSROOM TEACHER

Designed by E. Laurence Palmer



A FISHING TRIP TO THE POND

IF WE were to continue our fishing along the streams, we should find many more interesting creatures, but let us go now to some pond or little lake. The animals that we shall find in it will be in many respects like the ones along the river, so that the description of them will help to identify the things that are found along the stream.

INSECT LIFE OF THE POND

Wade out into the pond or even reach out from the bank with your net and prod the net into the bottom repeatedly. Move it along so as to catch in the net the things that you stir up by prodding; then bring the net to shore and turn the contents out on the ground. There will be found in this débris a variety of animals. They will not all appear immediately, but will wriggle their way out of the mud and dirt so that you will be able to pick them out as they become apparent. They can be dropped into one of the fruit jars, partly filled with water, so that it will be possible to see them better. You will find caddis fly larvae, somewhat like those that were discovered in the little brook. These are not attached, however, but go wandering around carrying with them their house made of bits of sticks cemented together. Another kind lives in a house that is just a length of the hollow stem of some reed or water grass. You see this bit of stem, perhaps an inch long, lying quietly in the mass of stuff that you have pulled out of the pond, when suddenly a little head and six legs appear at one end and the bit of stem starts to walk off.

There will be found also the nymphs or young of many dragon flies. A nymph looks much like the adult; a larva is a young animal that appears quite unlike the adult. Some of these nymphs will be nearly as large as your thumb. They are interesting creatures because of their method of capturing their prey. If you will take one of these nymphs in your

hand and examine the underside of the head, you will see that the mouth is covered by a mask that is on the end of a jointed arm. You can gently take hold of this mask and pull out the jointed arm so that the mask is extended perhaps half an inch in front of the mouth. On the end of the mask is a little pair of extra jaws. Some of these dragon fly nymphs that live on the bottom of the pond are mud-colored. Other species that live on the stems, reeds, or rushes are green, to match the color of the stem on which they live. The dragon fly nymph, inconspicuous because of its coloring, waits until some small insect or insect larva comes near it, when it shoots out the mask, grabs the creature in the little jaws, and pulls it down to the mouth so that it can feed upon its victim.



The dragon fly (*Epiaschura heros*) just after leaving chrysalis

When the dragon fly nymph is fully grown it crawls out of the water, climbs up on some twig or stem of water plant and transforms into the adult. The skin of the nymph breaks down the back and out of the opening the adult crawls. At first its body and wings are limp, but it stands in the air and sunshine for the body coverings to harden and pumps air into its wing-veins so they will expand. Thus it becomes the well-known dragon fly. These dragon flies will be seen hovering over the pond, darting over the marshes and the plants along the margin of the river. They are also known as devil's darning needles, snake doctors, and sewflies. Children sometimes fear them and have a notion that they can sew up their mouths or ears, but they are perfectly harmless insects; in fact they are very beneficial, for they feed on smaller insects which they capture and eat while on the



The damsel fly (*Calopteryx maculata*) on a leaf

wing. Mosquitoes are one of their favorite articles of diet, so they are sometimes known as mosquito hawks.

There are dozens of different kinds of these dragon flies, some to be found along the brooks and rivers and others about ponds and swamps. One very common one has four conspicuous black spots on each wing. Then there is a very large species of which the body of the male is green and that of the female is blue. Another one that is common over the ponds has a white abdomen and white and black spots on the wings.

The female of the dragon fly lays her eggs in the water. You may see a female hovering over the surface of the pond and repeatedly dipping the end of her abdomen into the water, depositing an egg each time. Or you will see a dragon fly standing near the edge of some water leaf, like that of a pond lily, with the end of the abdomen thrust down into the water. She may be fastening the eggs to the underside of the leaf or to the stem of some water plant. These eggs hatch out into the nymphs which are very tiny at first, but which grow gradually to the full-sized creatures we have caught in our net. It may take the nymph two or even more years to become mature and ready to transform into the

adult dragon fly, or it may go through the process in a single year. The time varies with the species. The long-lived ones bury themselves in the mud at the bottom of the pond and so carry over from one summer to the next.

We shall find also in the débris from the bottom of the pond, the nymph of the damsel fly. Some of these creatures we have already found in the water of the brook. These nymphs are rather long and slender and have two large leaflike breathing plates at the end of the abdomen. The adults look somewhat like the dragon fly, but are not so robust, and when they alight they usually fold the wings down the body of the insect instead of holding them out at right angles to the body as do the dragon flies. The nymph transforms to the adult in much the same way as does the dragon fly nymph.

If you will look carefully on the stems of cat-tails, bulrushes, or the shrubs growing along the pond margin, you will probably find the cast-off molt skins of damsel flies and dragon flies where the actors of this drama of the pond have changed their garments as they ceased playing their part in the water rôle, to take on their new act as dragons in the air.

Among the first creatures to make themselves conspicuous as they wriggle out of the débris from the pond will be some large shiny black beetles whose hind legs are flattened out into effective paddles. These are the water scavenger beetles. Their larvae, thick-bodied and somewhat grublike creatures, live also in the débris at the bottom of the pond. The body tapers from the middle both toward the head and the tail. The head is rather small, and the six little legs are feeble.

The larva of another one of these water beetles is known as the water tiger. It has a very large head, armed with strong sickle-shaped jaws. The legs of this larva are strong and conspicuous. It grabs its prey with its strong pincer-like jaws and sucks out their body juices. It will thus kill other insects, tadpoles, small frogs, and fish. If captured it needs to be put into a jar by itself, otherwise it will kill many of the other insects that are placed with it.

Another shiny black insect that will jerk its way out of the débris by means of powerful hind legs that stand out at right angles to the body is the water boatman. When dropped into the water it will swim rapidly, using these powerful back legs as oars.

The back swimmer is another insect with conspicuous hind legs used for swimming. It holds the rear part of these parallel to the margin of the body instead of out at right angles as does the water boatman. The commonest species of this insect is white on the back and when thrown into the water it swims back down.

There is a large water bug found in the ponds that is also known to many children, because in the late spring it is attracted by the electric lights in town. Sometimes it is found on the ground under such electric lights in large numbers, and is known as the electric-light bug. The body is boat-shaped and rather flat. The line down the middle of its back is a zigzag line instead of a straight line as it is in the beetle. Its front legs are provided with powerful hooks by means of which it captures its prey. The mouth is provided with a rather long sucking tube. This tube is thrust into the body of the animal it catches and so it sucks out the body fluids. It thus kills even fairly large fish, frogs, and other animals living in the pond. It is also known as the giant water bug. Be careful in handling it.

One of the strangest creatures that is to be found in the pond and stream is a very long-bodied bug with long slender legs. It looks somewhat like the walking stick found in the woods, but it has at the hind end of the body a long hollow tube. This water scorpion stands head down on the stem of some water plant. It looks so much like just a bit of stick that unsuspecting creatures will swim near it. It grabs them with its hooked forelegs and sucks their body juices. The long tube at the end of the body is thrust up so its end is above the water, and through this tube the animal breathes. Man has learned how to send down to the diver, working below the surface, a supply of air by means of a rubber tube

or hose. Here is an insect that had perfected this device long before man appeared on the face of the earth.

All the insects are air breathers and they must all have some device for carrying the air with them under water when they take to the aquatic life. If you watch the diving beetle in the pint fruit jar you will see that every once in a while he comes to the surface, hangs head down and sticks the end of his body up into the air out of the water. Underneath his shiny wing covers there is a large air space which he thus fills with air. Then he can swim under water until this air supply is exhausted, when he must come to the surface to repeat the process.

One of the animals that probably will be dredged up from the pond is the six-lined spider. If you watch the surface of the pond among the reeds and grasses, you will see this same spider running on the surface of the water. One marvels to see a spider thus able to walk on the water. This animal is brown with black and white stripes on the back. The body is perhaps as large as the last joint of your little finger. This spider also has tufts of hair on the feet that spread the weight of its body over a large surface of the water and so enable it to hunt for its insect prey where other spiders cannot venture. Not only can it run upon the surface, it can also go under water. It captures many of the insects from which it feeds by diving after them. It is known as the diving spider.

Strangest of all, it raises its young under water. When it dives into the water it carries its supply of air as bubbles of air held in the silky hairs that cover its body. When under water the body shines as if it were covered with drops of mercury, because these bubbles of air reflect the light. It fastens together several stalks of water plants below the surface and spins a bell-shaped web with these grass stalks as the supporting ribs. The mouth of the bell is pointed down. In the bell the eggs are laid and the young spiders reared. To supply the eggs and young with air the spider goes to the surface and meshes the bubbles of air in her hairs, dives to the nest, and stands at the mouth of the bell and with her

legs scrapes the air off her body so the bubbles rise into the bell and fill it. This she does repeatedly, so as to provide the growing young with air, until they are old enough to come to the surface to get their own.

Probably in the water that you dip up from such a pond will be found the larvae and pupae of the mosquito. The mosquito larva is a somewhat wormlike creature with rather a large head and tufts of bristles at the end of the body. It swims by twisting the body into an "S" shape and then suddenly untwisting it and forming an "2" with the opposite curve. It is commonly known as the mosquito wriggler. These are found not only in ponds and quiet streams but in the water of rain barrels or in that accumulating in empty tin cans, or even in some slight depression in the ground. The mosquito larva must also come to the surface to breathe. It supports itself by the tufts of bristles at the end of the body and hangs head down in the process. When its breathing tubes are loaded with air, it can swim under water for a short time to feed, but it must come repeatedly to the surface to get air.

When the larva is fully grown it changes into a pupa, a creature with a very large head and diminutive body so that it has the shape of a comma. Now the breathing tubes are on the top of the head and these must be thrust out of the water in order to get the necessary supply of air. The pupa finally breaks its skin down the back and the mosquito crawls out of the rift and stands on the floating pupal skin while its body hardens and its wings spread. These mosquito larvae and pupae are the favorite food of some small fish like the top minnow and Johnny darter. Ponds that are well stocked with such small fish are not likely to produce swarms of mosquitoes.

Since the mosquito larva and the pupa can breathe only by coming to the surface and sticking their breathing tubes up into the air, the animals are killed by spreading oil upon the water, so that the surface of the water is covered with an oil film. Neither the larva nor the pupa is strong enough to

thrust its breathing tubes through this tenacious film of oil, and therefore it dies for lack of air.

THE FROGS AND TOADS

You may dredge up from such pond a little salamander-like creature two or three inches in length, mottled brown above and pale salmon below. These are the efts that belong to the same group of animals as do the frogs and toads. In such a pond we should expect to find the frogs. There are many species of them, among which is the big bullfrog, a foot in length from the tip of the snout to his outstretched hind feet. This frog croaks with a noise like the moo of a cow. In the early spring one finds a little spring peeper whose note is like the whistle of a bird. Then there are the green frog, the pickerel frog, the leopard frog, and others.

The leopard frog is yellow underneath and pale yellow-green above with black blotches. The pickerel frog is pale brown above and marked with three rows of squarish black spots. It is white below. The green frog is pale green both



Common newts, or red efts (*Notophthalmus viridescens*) in water. (See Field and Laboratory Work, Vol. V, p. 420, for a graph showing the life cycle of the newt)

above and below and marked on the back of legs with black spots.

In the spring one will find the frogs' eggs in such a pond. Each egg is spherical, about as large as the head of a small black pin, and is black above and white below. Each egg is surrounded by a layer of jelly. The eggs are laid in masses, a single frog laying several hundred. The frogs seem to select the same spot for laying their eggs, so that you may find a half-bushel of these egg masses in two or three square yards of pond bottom. The eggs are usually laid in a shallow portion of the pond and are fastened to the stems of pond grasses. One may expect to find the eggs almost as soon as the ice is off the pond in the spring.

If you will take home in your pint fruit jar a few of these eggs and put them in the aquarium you can watch the various stages of development. Examine the egg masses as you find them in the pond. The frogs usually lay their eggs very early in the morning. A freshly laid bunch of eggs will show each egg dividing into two parts, in a plane that runs through the center of the black area and the center of the white area. These two centers are known as the poles of the egg. By the time you get the frogs' eggs that were found in this two-cell stage back home probably each half has divided again in a plane at right angles to the first division. In about an hour a third division occurs, in the equatorial plane. Such divisions occur repeatedly until a spherical mass of these little cells is formed. This mass elongates and you can soon distinguish the head end of the forming tadpole from the tail end. In three or four days' time the little tadpoles have wriggled out of the jelly that surrounded the egg and are attaching themselves to the glass sides of the aquarium by means of mouth suckers. For a day or so they will not feed, then they begin to eat the egg jelly and the water plants found in the aquarium. In due time the tadpole grows legs, first the hind legs, then the forelegs, and it gradually absorbs its tail. At this stage the tadpoles need to have a piece of wood or an island of soil in the aquarium onto which they can crawl, because they are

transforming now from water-breathing creatures to air-breathing forms.

About a month after the frogs' eggs are found abundantly in the ponds, one will expect to find the toads' eggs in ponds and streams. While the toad lives on dry land most of the year, it takes to the water to lay its eggs. Toads' eggs are very similar to the frogs' eggs, except that they are laid in long strings of jelly instead of in jelly masses. You will find them festooning the water plants of the stream margin or the pond. Sometimes in late spring or early summer, you will find the margin of temporary ponds that are gradually drying up fairly alive with little toads. The eggs hatched out in the early spring and now the toads are about ready to leave the pond and take up their lives in the fields and meadows.

A LITTLE JOURNEY TO THE POND TO STUDY PLANT AND ANIMAL ZONING

ARRANGEMENT OF THE PLANTS IN ZONES

IF YOU stand on a little hill where you can look down on the pond you can see that there is a distinct arrangement of the plants in zones. At the center of the pond is an area of open water. Around that, a ring of water lilies. Then farther toward the shore is the zone occupied by bulrushes. Still farther shoreward come the cat-tails, then certain shrubs peculiar to the water margins, and finally outside of this perhaps trees or meadows.

As a matter of fact, the area at the center of the pond that seemed from a distance to be free from plant life is found on closer inspection to have growing in it a number of water plants that are submerged. These root in the mud or sand at the bottom and then grow up part way to or even up to the surface. Here we find such plants as the pondweed, the water milfoil, hornwort, bladderwort, tape grass, and water buttercup. The water milfoil has very finely dissected leaves that grow rather close to the stem, so that under water the



Photograph by Downing

This is an excellent example of the pond zonation described on page 77

plant has a ropy appearance. The bladderwort also has very finely dissected leaves and grows in long ropes, but on the leaves are found numerous little air chambers like tiny bladders. These bladders are traps that catch tiny water creatures and digest them as food for the plant. The bulrushes have long tapering solid round leaves and stalks, the centers of which are filled with coarse pith. Among the bulrushes one often finds growing the arrowhead, a plant with arrow-shaped leaves and clusters of pretty white flowers.

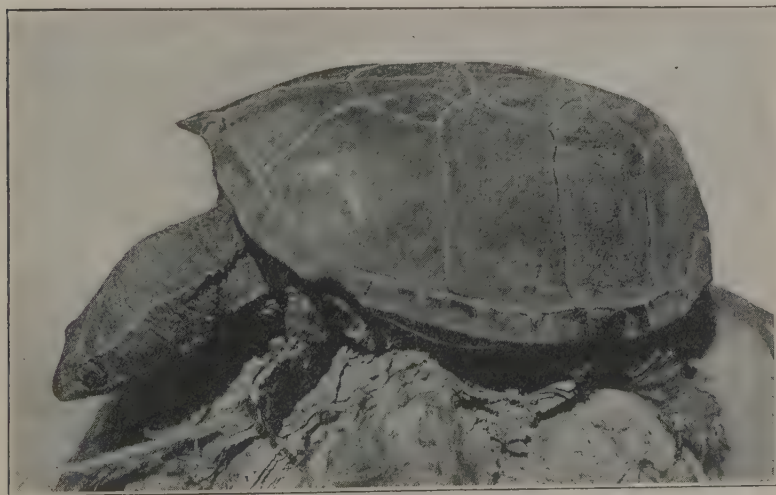
ANIMAL LIFE OF THE DIFFERENT ZONES

In the bulrush zone the marsh wren makes its nest. It fastens together a number of the bulrush leaves and at the juncture weaves its spherical nest of coarse stems and leaves and lines it with the soft down from the bulrush seeds. The opening of the nest is at the side. Among the cat-tails the red-winged blackbird and the yellow-headed blackbird build their nests.

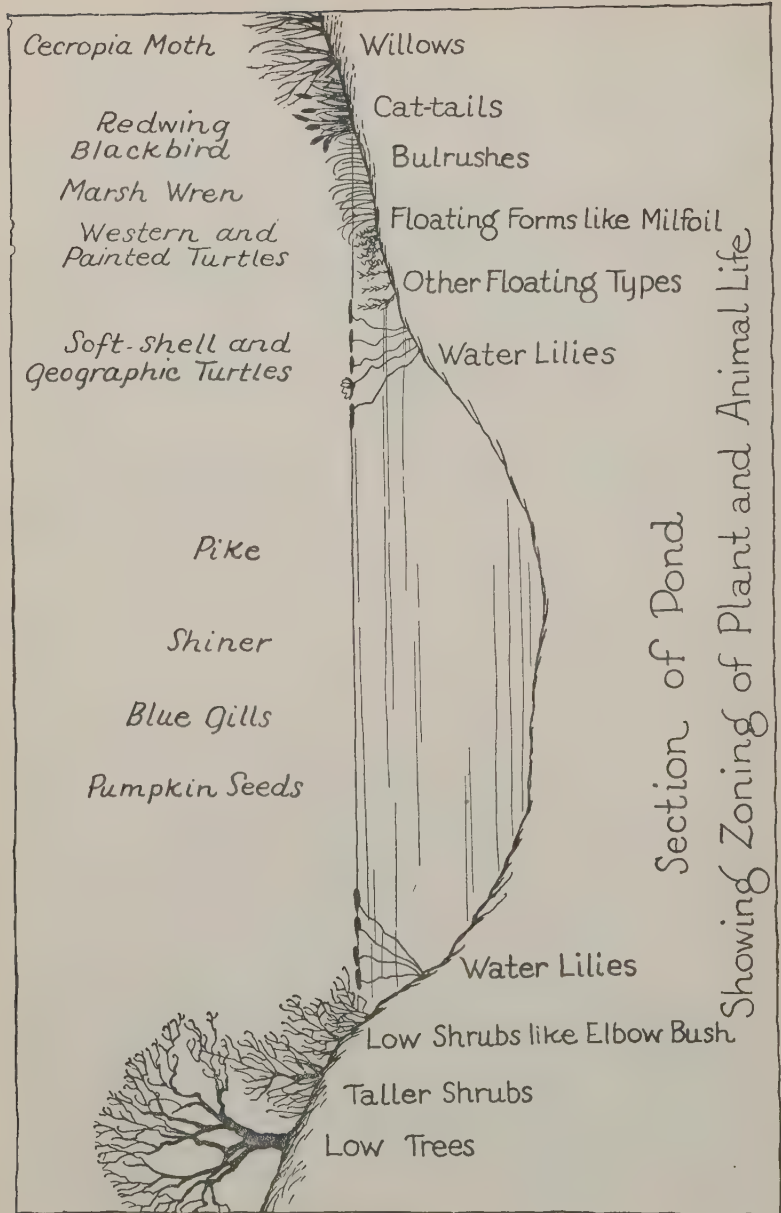
In the bulrush zone or at its margin, near the open water,

one will find living the turtles. Of these the commonest is the painted turtle, whose shell is decorated with blotches of yellow and red. The coloring is especially bright along the margin of the underside. It is around the margins of the area occupied by the floating plants that one finds most commonly the soft-shelled, the musk, and the geographic turtles. The soft-shelled turtle has a somewhat leathery instead of a bony covering. The musk turtle is so named because of the musky odor that it gives off. The geographic turtle has each of the many plates that go to make up its shell covered with fine lines, making it look somewhat like a miniature map. In such ponds one also finds the snapping turtle, whose shell is too small for its body so that it cannot withdraw completely into the shell. The tail is rough with pointed scales and the feet are armed with heavy claws. The snapping turtle also has a mouth that is provided with a horny beak and the length of its neck is surprisingly great. One needs to be a little careful in picking up this animal because it can give a vicious nip.

In such ponds one frequently sees the houses of the musk-



The musk turtle (*Aromochelys odoratus*) is found in the bulrush zone



rats. These are built somewhat in the shape of an inverted bushel basket. They are constructed of cat-tails, decomposing vegetable matter, and mud that is dredged up from the bottom. There is a single room in the center of the house above water level, with a passageway leading out and opening under water. Not infrequently around the house and even inside the house will be found the empty shells of clams, which apparently are one of the favorite foods of the muskrat.

One will also find the little hell-diver or pied-billed grebe in such ponds. This little bird is also called the mud hen. It looks something like a duck but dives when frightened instead of flying. It has almost no tail and the feet are set well back toward the hind end of the body. It captures its food—small fish, insect larvae, etc.—by diving and swimming for it under water.

Along the margins of such ponds and among the cat-tails and bulrushes are to be found feeding certain long-legged wading birds. There is the American bittern and its close relative, the least bittern. The American bittern is also called the stake driver or pump bird because the note it emits is something like the noise that one makes in driving a stake into the wet ground or in operating a dry pump. The bird stands two feet or more in height and the general color is brown. The head and throat are marked with lines of buff and dark brown, almost black. The bird is provided with a long sharp beak and it is an expert in spearing fish, frogs, and similar water creatures as it wades around in the shallow water. When disturbed in its fishing operations, it usually sticks its head straight up in the air. Its appearance then is so like that of some old tree branch among the rushes that it easily escapes detection. You may look right at the bird without seeing it and be surprised when this old snag jumps out and takes sudden flight. Its nest is placed among the dry rushes and sedges on the shore. The bird is careful to cover the eggs with the plants when it leaves for feeding, so that it is a difficult matter to discover the nest.

A LITTLE JOURNEY TO THE SWAMP

WE HAVE seen in the earlier pages that ponds and lakes are constantly filling up. A pond tends to change gradually into a swamp and the swamp ultimately fills up and becomes a wet prairie or woodland.

CHARACTERISTIC PLANTS OF THE SWAMP

The plants of the swamp are quite characteristic. In the ordinary swamp we shall find, where the water is standing, such plants as the arrow leaf. This plant has large leaves shaped like an arrowhead and it bears white blossoms. Here, too, will be found the bur reed, a somewhat grasslike plant, the blossoms of which occur in balls around a tapering terminal stalk. Bulrushes and ordinary rushes similar to those found along the margins of ponds are also common in the swamp. The water reed, a tall grasslike plant with very large feathery clusters of blossoms, made up of small individual flowers, is another conspicuous plant. Sweet flag is common, as well as the blue flag.

The blue flag has conspicuous three-parted purple flowers, the stamens looking like petals. The foliage of the sweet flag looks somewhat like that of the blue flag, but the underground stems have a sweet odor and taste. The water smartweed is also common. The leaves are lance-shaped and in some species there is a conspicuous black mark on each leaf, looking something like the imprint of a dirty finger. The blossoms are small individually, but the cluster is long, tapering, and conspicuous because of the bright pink or red color. Toward the end of the summer turtlehead is seen. The large white blossoms appear in clusters in the axils of the upper leaves. Each blossom, nearly an inch long, is shaped like a turtle's head with a gaping mouth, beaked above. The tall stems of joe-pye weed are easily recognized by their flat-topped clusters of purple blossoms and their whorls of four lance-shaped leaves. The swamp thistle is



(Circle) Courtesy, Wild Flower Preservation Society

Above, left to right, are the hyssop-leaved skullcap (*Scutellaria integrifolia*) and the turtlehead (*Chelone glabra*). Below are the sweet flag (*Acorus calamus*) and the blue or great lobelia (*Lobelia syphilitica*). In the center is the horse-tail (*Equisetum arvense*)



Photograph by Downing

Advance of rushes upon a swamp in the Indiana dunes

common. Its pricklers on the leaves are not very stiff. The blossom heads are red-purple and the green scales on the outside of the heads are sticky.

Back still farther, on a somewhat drier land, occur very many sedges and grasses. The former are known by their triangular stems. The swamp fern is common. The river horsetail, chickweed, skullcap, and mermaid weed are abundant. Occasionally one will find the brilliant red blossoms of the cardinal flower, and the blue lobelia, a close relative of the cardinal flower. The upper petal is split and the pistil protrudes through the slit. Along the margin of such a swamp, one finds a zone of willows. Back still farther where the swamp is growing up to trees will be found such trees as swamp oak; swamp hickory, with seven to eleven leaflets on its compound leaves and with its small bright yellow buds; white and green ash, with their coarse opposite twigs; sour gum, a tree whose trunk runs straight to its top and whose branches droop so that in form it is much like a conifer.

ANIMAL LIFE OF THE SWAMP

The insect life of such a swamp is abundant. The grasses and sedges hide many grasshoppers and their kin. The forked-tailed katydid and the Texas katydid are usually abundant, and the notes of these animals and their relatives make the swamp a noisy place in late summer and early fall.

Nesting among the bulrushes, one often finds the marsh wren, while in the cat-tail zone, red-winged and yellow-headed blackbirds build their nests. Such wading birds as the American bittern, the least bittern, the Florida gallinule, and the Virginia and sora rails are also to be found.

The Florida gallinule is a blue-black bird with a blue bill. Its feet instead of being webbed as are those of the duck have a narrow fringe of web along each toe. The rails are birds with very long toes on their feet so that they can walk on soft ground without sinking in far. Their bills are quite long and they probe into the soft ground for food. The Virginia rail is the larger of the two mentioned. Both are brown, mottled with darker brown.

Where little pools of water stand in the swamp, the same animals are common that have already been noted as characteristic of the pond margins.

A LITTLE JOURNEY TO THE TAMARACK SWAMP

THERE is another type of swamp which ultimately grows up to a tamarack forest. Such swamps, bordered with tamaracks, are fairly common, and the plants and animals in them differ decidedly from those of the ordinary swamp.

PLANT LIFE IN THE TAMARACK SWAMP

In the center of such a bog may be found a remnant of the filling pond, with its water lilies and its submerged vegetation with plants like milfoil and chara, the latter having



Photograph by Downing

A filling pond in a tamarack swamp, showing zoning of plant associations

a distinctly disagreeable odor when it is pulled out of the water. Around the pond is a zone of floating vegetation. This consists chiefly of sedges whose fine interlacing stems make a mat. This floating mat is tough enough so that one can walk over it and even cattle may walk upon it. It quakes at every step and if you jump up and down upon it, waves run out over the tangled mat of vegetation as they would on the surface of the pond when you plunge in. There are in spots weak places in such mats, especially where cat-tails grow, and then one may break through into the shallow water of the bog.

As such a bog fills up, extensive areas of it may be covered with sphagnum moss. This moss is pale green and grows to considerable depth so that the sphagnum bog is soft. It holds water like a sponge. In such sphagnum areas, one often finds two interesting insectivorous plants, the little sundew and the pitcher plant. The small rounded leaves of the former are covered with sticky hairs. When a small insect alights on such a leaf, it sticks as it would to fly paper and then the leaf rolls together, so that many of these glandular hairs are pressed upon the insect and it is digested and absorbed to be used as food for the growing plant.

The leaves of the pitcher plant are shaped something like a pitcher, which on the inside is covered with stiff hairs that point down. The throat of the pitcher bears a mass of soft sweet tissue that insects feed upon with delight. Frequently an insect slips off this succulent mass and drops into the pitcher, the lower portion of which is partially filled with water. The insect cannot climb out because it encounters the points of the hairs. In time it drowns and this insect soup serves as food for the plant.

Certain orchids, such as the swamp pink, the ragged orchis, and fragrant lady's tresses, are common in these swamps. The vines of both the large and small cranberry creep over the pale green sphagnum. A grass, bearing in late summer a tuft of cotton at the tip of its stem, is a conspicuous feature. The seeds of this cotton-grass are carried through the air by the tufts of silky hairs, somewhat as are those of the cottonwood tree or the dandelion. The swamp fern is frequently found in such situations.

Still farther away from the wet center of such a pond, one finds the swamp milkweed, the marsh bellflower, tickseed,



Photograph by H. C. Sherman

Margin of tamarack swamp following heavy rainfall

boneset, and marsh skullcap. The sensitive fern and the royal fern are fairly common in the tamarack swamp, though these are quite as likely to be found along the margins of the ordinary swamp.

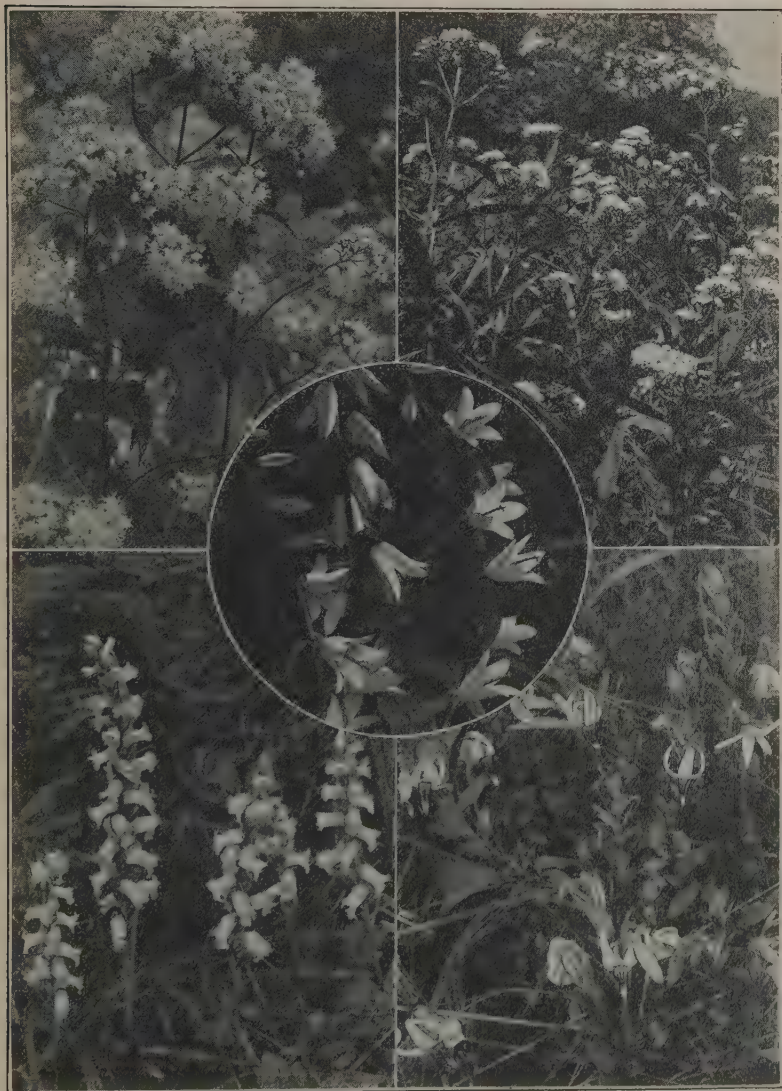
Swamp milkweed is recognized by its milky juice and by



Peculiar to the tamarack swamp are the privet andromeda (*Xolisma ligustrina*) at the left, and the red chokeberry (*Aronia arbutifolia*) at the right

its clusters of pendant pink blossoms with their cornucopia-shaped petals. Tickseed or wild coreopsis is a plant with much-dissected leaves. It is a composite. The ray flowers, which are broadly strap-shaped, are yellow, while the disk flowers are dark brown. Boneset, an herb much prized by our grandmothers for medicine, is a tall plant with a flat-topped cluster of small fuzzy purple blossoms. The bases of the opposite leaves fuse. Marsh skullcap is a plant of the mint family. It has blue flowers, which are two-lipped and which occur usually in pairs in the axils of the lance-shaped, serrate leaves.

The sensitive fern, so-called because it suffers at the first touch of frost, has a somewhat triangular leaf, cut into large lobes, not finely dissected as are most fern leaves. The royal



Above, left to right, the deerwort boneset (*Eupatorium ageratoides*) and the swamp milkweed (*Asclepias incarnata*). Below, the fragrant or nodding lady's tresses (*Ibidium cernuum*) and the American cranberry (*Vaccinium macrocarpon*). Center, the European bellflower (*Campanula rapunculoides*)

fern has large leaves that are two or three times compound. The spores of this plant are carried in clusters at the tips of the leaves.

Still farther shoreward comes a succession of shrubs that are peculiar to the tamarack swamp. Leatherleaf, andromeda, chokeberry, swamp birch, swamp rose, and poison sumac are among the characteristic shrubs. The andromeda or wild rosemary has narrow evergreen leaves with margins rolled back. The undersides of the young leaves are glistening white. The blossoms are urn-shaped and pink. The chokeberry has leaves that are shiny above, pale and hairy below. The flowers grow in clusters and look like small apple blossoms. The fruit also is a small red apple. On the outer margin of the shrub zone appear the young tamaracks. This tree is a conifer with needle-like leaves in clusters of sixteen to twenty-five. The leaves are shed in the fall so during the winter the trees are bare. Under the tamaracks there frequently is a mat of sphagnum with many of the plants growing in it that are characteristic of the sphagnum swamp.



Photograph by Downing

Border zone between tamarack swamp (right) and oak dune (left)

CHARACTERISTIC ANIMALS OF THE TAMARACK SWAMP

There are not many animals that are characteristic of these tamarack swamps. One of the tiger beetles, the bog tiger, is peculiar to its margins. The short-winged brown locust, with its striped legs, is found abundantly, usually along the border of the sphagnum bog. The marsh ground cricket and the small brown cricket are to be found in the shrub zone.

The tamaracks sometimes are infested with bag worms, the larvae of a moth that hides itself in silky bags attached to the twigs of the tree, and made in part of the tamarack leaves.

A LITTLE JOURNEY TO THE DUNES

ALONG the margins of some of the larger lakes, on the seashore, along the margins of certain large rivers, and in sandy and semidesert regions that have been lake bottoms in fairly recent geological times, there are frequently found sand dunes. They are abundant, for instance, in Cape Cod, along the southern and eastern shores of Lake Michigan, and along the southern shore of Lake Erie, in certain spots along the Mississippi, and in the arid regions of western Nebraska.

HOW DUNES ARE FORMED

On Lake Michigan the prevailing storm winds are from the north and northwest. The waves and water currents set in motion by these winds carry the sand formed from the pulverized rocks southward and pile it up offshore as sand bars. These gradually rise by the accumulation of additional sand until they begin to stick out of the water. As the waves break over these bars, they fill in the shallow water behind them, until the sand beach becomes continuous. Thus the lake is constantly pushing itself back as it forms new lands by its own efforts.

As this sand dries out, the same heavy winds carry it inland and begin to pile it up wherever any obstruction changes the velocity of the wind, just as snow is piled up in a drift by a fence. Thus wherever any little clump of grass gets started on these sandy shores, or where some shrub or grapevine grows and checks the wind, a diminutive dune starts. But the chief agency that serves to check the wind's velocity and so cause a dune is the cottonwood. This tree is one of the few living things that can stand the high winds, the extreme temperature, and the dry air of these open sandy places. Its seeds are readily carried by the wind and are produced in enormous quantities. Wherever any low area of the beach offers sufficient moisture, the cottonwood seeds germinate and a thick growth of the young trees occurs. Such low moist areas do occur fairly frequently and are extensive. Into such an extensive area of young seedlings, the wind brings the drifting sand. It piles up about the little cottonwoods. But they can grow rapidly enough to keep their heads above the drift. Thus the trees become larger and their branches form a still more effective barrier, so the drift of sand gradually rises into the proportions of a large dune. Cottonwoods continue their growth and you have a hill of sand perhaps fifty or one hundred feet in height, a quarter or a half mile long, the length of the dune roughly parallel with the shore of the lake. The top of the dune is covered with clumps of the cottonwood trees.

The cottonwood or Carolina poplar has greenish yellow bark at least on the branches. The leaves are triangular in outline. The young shoots have ridges on the bark running down from each leaf.

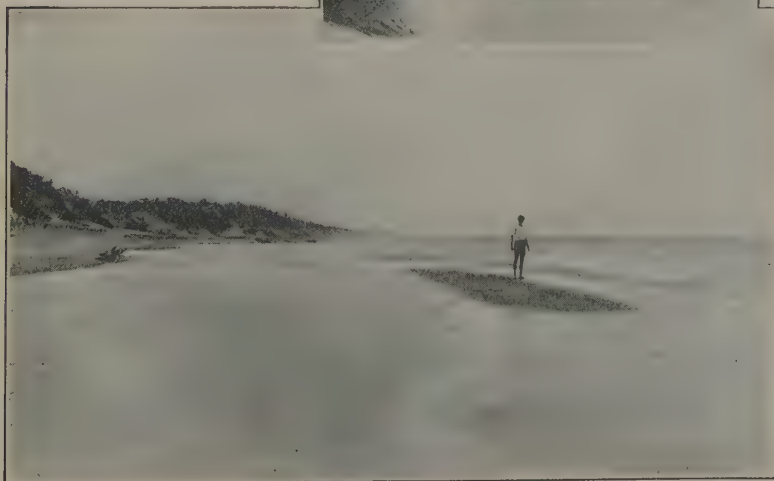
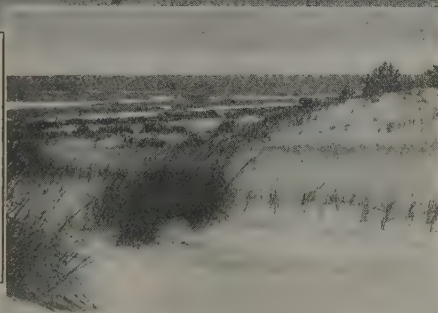
PLANTS WHICH HELP TO FIX DRIFTING SAND

Other plants assist in this process of affixing the drifting sand. Certain beach grasses like the marram grass and the bunch grass are conspicuous. Grapevines, red-osiered dogwood, and the basswood aid in the process. Red-osiered



Photographs by Downing

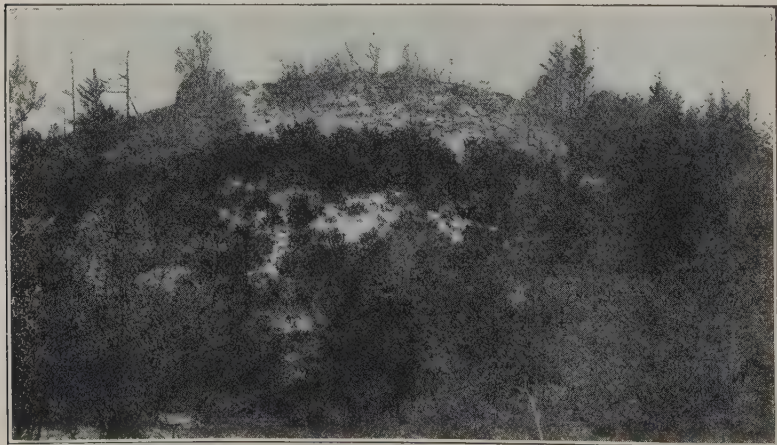
Sand dunes, showing: above, wormwood (tall plants in foreground) and bearberry (low clumps); right, bunch grass affixing the drifting sand; below, beginnings of a sand bar



dogwood has glistening red stems. In the fall the shrub bears clusters of white berries. The basswood or linden is a tree with large heart-shaped leaves, lopsided at the base. The twigs come off from the branch, one on one side, then one on the other, so that the branch is flat.

THE PINE ZONE

After many generations, such plants have somewhat enriched the soil by their accumulating rotting remains and when another dune has begun to form shoreward so that the cottonwood dune is no longer exposed to the fierce winds, other plants begin to come in and finally crowd out the cottonwoods. These are the white pine, the jack pine, and an associated group of evergreen shrubs, like the prostrate juniper, the spreading juniper, and the tall juniper or red cedar. Underneath such trees and shrubs will be found such low shrubs as the prince's pine, star flower, shinleaf, trailing arbutus, and bearberry. Other herbaceous plants are found in this association also. Solomon's seal, both the true and the false, bellwort, horsemint, and false lily of the valley are



Photograph by Downing

Edge of the pine zone in dunes



Photograph by Holmes

Courtesy, U. S. Geological Survey

Migrating sand dunes, destroying live oak and cedar forests

found, although they also grow back in the next succession.

The bearberry is a spreading evergreen plant, with leathery leaves. The flowers are urn-shaped and pink, and the plant bears a red berry that is mostly seed. Shinleaf has round leaves with little white flowers borne in a loose cluster. Prince's pine is a low upright plant with narrow leaves crowded at the end of the short stalk. The star flower is somewhat similar, but bears only a single star-shaped flower above the leaves. The junipers have short needle-like leaves that are irregularly placed on the twig. The tips of the leaves are sharp so that your hand is pricked as you take hold of the flower. Some of the leaves are turned underside out so that the light underside is conspicuous.

THE OAK ZONES

Many generations of these plants of the pine zone prepare the soil for the black oaks which in turn crowd them out. The black oaks are gradually replaced in the still older dunes by red and white oaks. Still farther back from the lake



Lousewort (*Pedicularis canadensis*) at the left, and wild bergamot (*Monarda fistulosa*) at the right, are found in the red-oak association

hickories begin to appear, and so we get the typical oak-hickory forest that has already been studied. In the black-oak zone one finds clumps of the staghorn sumac, dwarf sumac, aromatic sumac, and red-osiered dogwood, while woodbine, bittersweet, and poison ivy grow on the ground or drape themselves from the shrubs and trees.

These oak dunes are filled with flowers much of the time. Puccoon and bird's-foot violet, horsemint, wild bergamot, hairy phlox, columbines, lousewort, beach pea, and lupin are among the more conspicuous members of the red-oak association.

Close to the pine zone, with a vegetation that looks distinctly northern, one often finds in the red-oak zone a cactus growing in beds close to the ground. This cactus is a plant that comes from the desert regions of the Southwest, but has found a congenial home here in these sandy woods. In the same region is a little six-lined lizard, also more characteristic of the southwest deserts. It is a strange combination to see close together representatives of the northern flora and that of the desert of the Southwest.

The explanation, however, is simple. This region has been repeatedly invaded by glaciers that have pushed down from the north. As they advanced slowly through thousands of years, the deciduous forest trees were replaced by the conifers and associated plants, and even these were pushed pretty well south. Then as the glacier retreated the deciduous trees came north again, but the conifers in a few regions like this dune area have found a place where they can live, and so we have a northern flora in the midst of the deciduous forest that is the prevalent one throughout the region. In the intervals between glacial periods, the climate of this region has at times been considerably warmer than it is now, giving opportunity for some of the animals and plants that live farther south to push their way north, and some of them, like the cactus and the six-lined lizard, have found here in the dunes a region where they can still survive.

THE FOREDUNE

As a rule, not many plants can live on the shifting sands along the beach in front of the cottonwood zone. This area is exposed to the storm waves and only a few hardy annuals are found along the sand beach. Such for instance are the sea rocket, bugseed, winged pigweed, and seaside spurge. Back, near the limits of the beach the bunch grass, beach cinquefoil, rye grass, mullein, cocklebur, and sand thistle grow. Some of these plants are very interesting because they are also found along the Atlantic shores. Such for instance are the seaside spurge, the sea rocket, and the marram grass, all of which probably came into the region of the Great Lakes when it was invaded by the arm of the ocean, many thousands of years ago.

Back of this storm beach area, and in front of the cottonwood zone, is an area of small dunes that accumulate about such low shrubs as the sand willow and the sand cherry.

The sea rocket is a plant with thick fleshy stem and leaves. The blossoms are purple with four sepals, four petals, six

stamens, and a single pistil which gives rise to the two-jointed pod. Bugseed has slender tapering leaves and bears very many small hard fruits, each surrounded with a thin collar. Winged pigweed has coarsely toothed, lance-shaped leaves. The plant is much branched and bears small green stemless blossoms scattered all over the upper branches. Seaside spurge has a milky juice. The leaves are small and slender. The three-lobed ovary of the flower pistil stands up on a stalk above a whorl of bracts that looks like the corolla. The sand thistle has a pale green foliage, the pricklers are weak, and its blossoms, clustered in a head, are yellow. The sand willow is a low shrub with very hairy leaves and large stipules. Sand cherry is recognized by its dark shiny bark, its bitter-tasting buds, and its large, rather luscious fruits.

ANIMAL LIFE OF THE DUNES

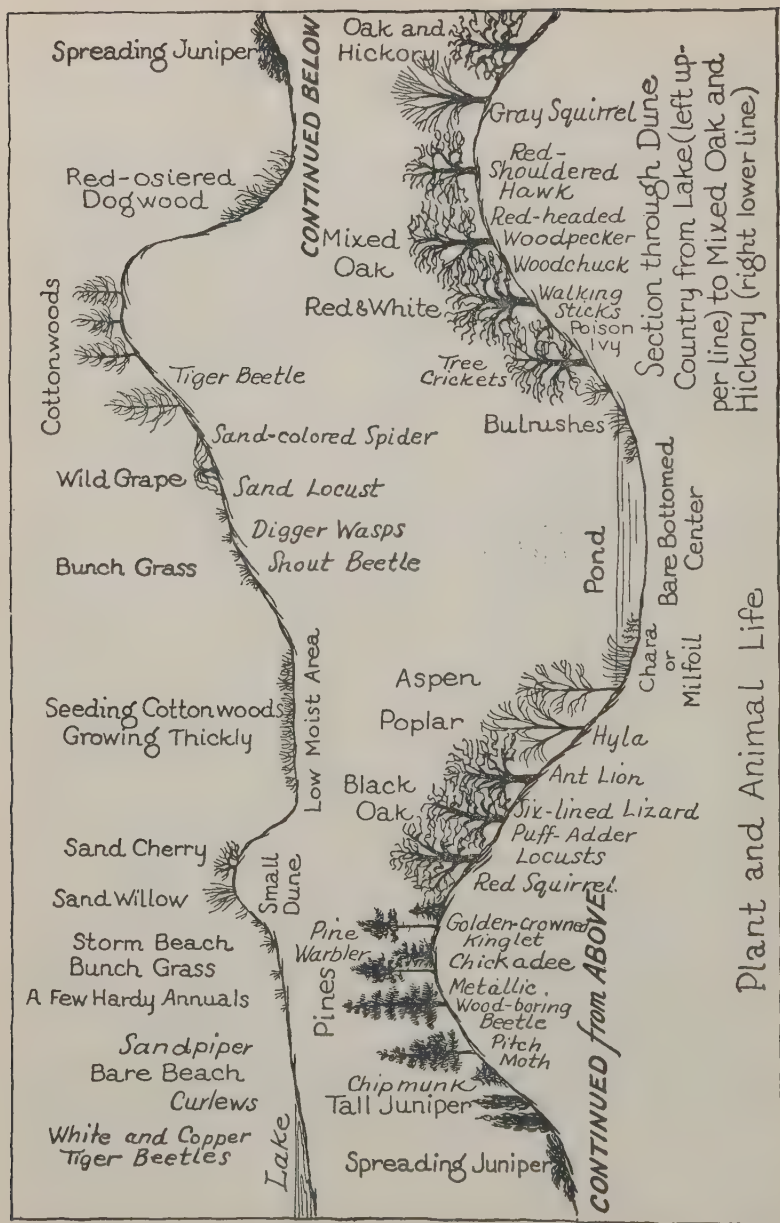
ANIMALS FOUND ALONG SHORE

The animals are quite as distinctly in definite associations as are the plants. Close to the shore one will find, especially in the fall during the migration, such long-legged shore birds as the least sandpiper, spotted sandpiper, sanderling, and knot, and occasionally the curlew, willet, and godwit. All these birds run along the shore and pick up insects or probe in the sand for food with their long bills. We shall find also great flocks of herring gulls that feed on the dead fish thrown up along shore or fly over the shallow water to dive for fish that they see below its surface. Franklin's gull and the common tern are other members of this shore colony.

There are certain insects that are found in this shore zone. Two tiger beetles, one white like the sand and the other copper-colored, run along the shore picking up insects that are washed in. Often there are found numerous insects that do not normally live here, but that have been washed ashore by the waves. They are carried out over the lake when the wind is blowing offshore, become exhausted, drop into the water and then are washed up when the wind shifts



Photograph in center by American Museum of Natural History Courtesy, U. S. Forest Service
 Above, left to right, are the fruit of the red-osiered dogwood (*Cornus stolonifera*) and fruit of the jack pine (*Pinus banksiana*); in the center, the white pine (*Pinus strobus*). Below are the shinleaf (*Pyrola elliptica*) and blossoms of the basswood, or American linden (*Tilia Americana*)



to blow inland. One often finds not only dead insects, but those that have survived their immersion. These crawl up out of the water and get under rocks and bits of board until they have sufficiently recuperated to fly back to their natural living place. It is this supply of insects that makes the beach so attractive to birds and predatory beetles.

There is another interesting group of insects which are frequent visitors along the beach, but whose homes are back in the shrub zone or the cottonwood zone. These are the digger wasps. These wasps excavate their holes in the sand in the shrub and cottonwood zone, digging the hole much as a dog would dig. The terminal joints of the front legs are broadened and by the aid of these broad joints the animal scratches out sand and throws it out between the hind legs. When the hole has been thus dug, the animal goes down to the beach to capture flies that are preying on the dead fish or to obtain other small insects, and these it brings back to its hole. Having stocked the hole with the insects which are paralyzed by its sting, the wasp deposits its eggs in the hole and then fills in the mouth of the excavation, obliterating all traces of its presence. In the hot sand the eggs hatch rapidly and the larvae feed on the insects provided by the mother wasp. The larva when full grown goes into a resting stage, the pupal stage, and in the course of a few days transforms to the adult, digs its way out of the shallow hole, and in due time proceeds to repeat the process.

ANIMALS OF THE COTTONWOOD ZONE

In the cottonwood zone there is found another tiger beetle, light brown in color, with yellow markings on its back. There are several insects here on the open sand that are colored like the sand. Such are the maritime locust and the mottled sand locust. When the former is in flight the wings appear pale yellow, with a black band along the margin. Then the insect is quite conspicuous, but when it folds its wings and drops on the sand it disappears as if by magic, for the color is then so exactly like the sand upon which it alights that, although it

is nearly an inch long, it is difficult to see it. Here also is a sand-colored spider that hunts over the open area looking for insects that it may pounce upon. One will find also another spider similarly sand-colored, but it is out only during the early morning and dusk of evening. The rest of the time it remains in its hole which it digs vertically in the sand. This animal is found not only in the cottonwood zone but back in the oak areas. This spider when mature is large enough so that with legs outstretched it will cover the palm of the hand. The hole for such a spider has an opening that is perhaps three-quarters of an inch in diameter. The hole is dug down into the sand a foot or more. The upper part of the hole is lined with silk so the loose sand will not cave in. In the early morning one will find the hole surrounded by a ring of moist sand pellets which the spider has thrown out in excavating the burrow. These pellets dry out later and are not visible on the dry sand.

ANIMALS OF THE PINE ZONE

In the pine zone one occasionally finds in old pine logs the larvae of long-horned beetles that are peculiar to the pines. The feelers are twice the length of the body. When the animal is held near your ear, you hear a peculiar grunt. This sound is thought to be the call of the insect used so that in the intricate chambers which it hollows out in the log it can find its mate. Another wood borer found in the same logs is a beetle with a bright coppery metallic luster. This animal is about three-quarters of an inch in length.

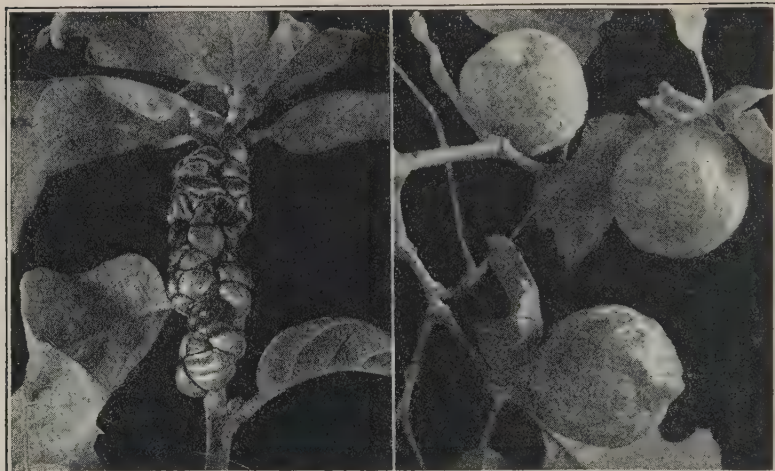
The downy and hairy woodpeckers are found here among the pines, although they are quite as frequent back in the oak territory. Certain birds, however, are characteristic of the pines, especially in the migration season. Golden-crowned and ruby-crowned kinglets, pine warblers, and black-throated green warblers are more likely to be found here than in the adjacent oak woods. The black-capped chickadee is prevalent. We also find the red squirrel and the chipmunk in these pine areas in the woods farther north.

ANIMALS OF THE OAK ZONES

One very interesting animal found in the black-oak region and common in sand regions throughout the country is the ant lion. The larva is more conspicuous than is the adult. The larva is a flat six-legged creature, the size of one's little finger nail, and it is provided with conspicuous curved pointed jaws. It excavates a conical hole in the sand and lies buried, jaws up, at the bottom of the hole. When an ant or other small insect steps on the steeply inclined side of the hole, it slides down toward the bottom. If it does not quite reach the bottom, the larva throws up little spurts of sand, which help to bring the struggling insect within its reach. It is then seized by the jaws of the larva which proceeds to make a meal on it. If a bit of grass is stuck down into the depression, the larva will often seize it and allow itself to be dragged out of the sand before it will loosen its hold.

If some of the larvae are dug out and taken home and are thrown onto the surface of some sand in a cup or a dish, they will dig their holes and wait in confinement for food. If fed daily with ants or other small insects, the larvae will go into a resting stage, usually within a week or ten days. They will, however, live for many months without food, patiently waiting at the bottom of the depression for some unwary insect to afford them a dinner. When the animal goes into its pupal stage it forms around itself a hollow sphere of cemented sand particles. The adult that finally emerges from this is a long-bodied slender insect with gauzy wings that looks something like a weak damsel fly.

On the ground under the oaks will be found a new group of grasshoppers and their close relatives. The rusty locust, the leather-colored locust, the coral-winged locust with its bright red wings, and the straight-lanced and sword-bearing grasshoppers are among the ones most commonly found. In the females of the two latter animals, both of which are green in color, the hind end of the body bears a long sword-shaped ovipositor. In the straight-lanced grasshopper it is



At the left is the fig oak gall (*Xanthoteras forticornis*); at the right, the oak apple (*Amphibilops confluentus*)

longer than the body and straight. In the sword-bearing grasshopper it is not so long as the body and curved. The sword-bearing grasshopper has a very pointed head and relatively short antennae, while the straight-lanced has antennae longer than the body and sword put together.

On the oaks here, as well as in other situations where oaks are common, curious swellings known as galls will be found on leaves and twigs. There is one found growing on the leaf of the oak that is spherical and as large as a small apple. The inside is filled with spongy tissue. This is known as the spongy oak apple. Another one looks like it on the outside but is hollow on the inside, except for some strands of material that run from the shell toward the center. Another sort grows on the twigs of the oak in clusters. The individual galls when young are as large as small marbles and are spherical in shape but they crowd each other out of shape so that they look somewhat like figs that are packed together in a box. On that account this is called the fig oak gall.

These galls are in most cases formed when a little insect like a tiny fly with the hind end of its body cut off sharply

lays its eggs in the leaf bud or bark of the plant. The irritation produced by the presence of the eggs or substances which it secretes causes the plant to grow the gall. The larva feeds on the soft tissue that is so produced. When it is mature it pupates and later changes to the adult gall fly.

On the surface of old galls, one will frequently find the little circular holes out of which the gall fly escaped at maturity. One finds these galls not only on the oaks, but on many other plants. There is a woolly one that grows on the stems of the wild rose and a spindle-shaped one that is found commonly on goldenrod.

A LITTLE JOURNEY TO A ROCKY HILL

IN SOME ways a rocky hill has many of the characteristics of an open sand dune. Because the soil is absent or is found only in scattered shallow patches, there is little moisture available, and only those plants can grow which can stand such a condition. Both on the rocky hill and in the open dunes, plants are exposed to the intense sunlight and the extremes of temperature from hot noontime to cool midnight. There is some similarity, therefore, in the plants found growing in these two situations. Thus on some of the rocky hills in southern Wisconsin, one finds the same cactus that grows in the dunes. Its thick succulent leaves enable it to store moisture, during and immediately after a shower, that will tide it over a long dry spell.

PLANTS ON THE ROCKY HILL

In the black-oak area of the dunes and on rocky hills, the ground is sometimes covered over wide areas with such mosses as the hairy caps and with lichens. The hairy cap moss has a stem perhaps an inch high and bears somewhat needle-like leaves. From the top of the stem there may be found growing at certain times of the year a naked stalk on the end of which is a capsule, like a diminutive salt shaker.

*Photograph by Hillers**Courtesy, U. S. Geological Survey*

Natural Bridge, Virginia, formed by wind and water erosion

This capsule may be covered by the cornucopia-shaped cap made of interwoven hairs. Such plants as the moss do not produce seeds but a new plant can grow from one of the tiny spores that shake out of the capsule. The individual spore is so tiny that one cannot see it except under a microscope.

The lichens are of many colors and many shapes. One that is common both on the ground and on the trunks of trees is greenish-gray, forming a thin flat irregular sheet of tissue that fastens on by means of rootlike holdfasts. After a dry spell, these lichens are very brittle and apparently have largely ceased their activities. Mosses and lichens seem capable of thus largely suspending operations during a

drought, but when rains come or the air is very humid the tissues of these plants become soft and pliable and the plant resumes operations. Such plants are, therefore, well adapted to live in situations like the dunes or a rocky hill where the supply of moisture is intermittent.

Usually the first plants to grow upon bare rock surfaces are the lichens. Some of them adhere so closely to the rock that they appear more like a coat of paint than like a living thing. Many of them are quite brilliant in their colors, yellow, red, black, or white. Often the different kinds are mixed together on the surface of the rock so it is encrusted with a variety of colored growths. These lichens in their growth, and also when they die and decay, produce acids and other chemical substances that help to disintegrate the rock, although, of course, very slowly.

Lichens and mosses are also very hardy plants in their ability to withstand both high and low temperature. Because of their ability to withstand the cold they make up the bulk of the vegetation growing far north or up beyond timber line on the mountains where trees and shrubs and less hardy herbaceous plants cannot survive.

Besides the encrusting lichens and those with flat leaflike expansions, there are many that grow up from the ground with numerous short branching stems. Such a lichen is the famous reindeer moss. It is one of the staple articles of diet of the animal from which it gets its name. This lichen is found in the dunes and on many rocky hills, as well as in the tundras in the arctic regions. Its gray branching stalks set close together form a soft carpet in moist weather, but a brittle one that crunches beneath the footsteps when the weather is dry.

The soil on a rocky hill often accumulates in cracks and crevices when it is washed off the rock surfaces, so one finds such plants as can grow here at all frequently confined to the cracks. Mosses may cover the ground in such crevices. The rock spleenwort may be found growing here. This is a little fern with leaves five or six inches long composed of narrow



Above are the polypody fern (*Polypodium vulgare*) and hair-cap moss (*Trichostomum*). Below is the rock spleenwort (*Asplenium trichomanes*)

leaflets growing out from the midrib. The back of the leaf is dotted with black spore clusters.

Another fern likely to be found is the rock polypody. Its fronds are ten or more inches in length and coarser in texture. The clusters of brown spore cases grow close to the leaf margins.

Some of the shrubs characteristic of the pine zone in the dunes will get a foothold in such crevices. Such are the bear-

berry, checkerberry, arbutus, blueberry, and gooseberry. In the larger crevices, such trees as the chokecherry, pin cherry, white birch and white and red cedars, better known as the arbor vitae, and the tall juniper may gain a foothold.

HOW SOIL IS FORMED

A visit to such a rock hill will show to one who looks sharply many examples of the formation of soil. For soil consists of tiny particles of rock mixed with more or less decaying plant and animal matter. If you break a corner off a ledge of rock exposed on the hill or from a boulder found in the field you will see that the outer portion differs in color from the freshly broken inner part and frequently is much softer. The moisture of the air and the gases of the air unite with the minerals of the rock and change them. With a knife one can often scratch deeply into this weathered rock down to the solid unchanged rock that is seen on a fresh break. The lichens and mosses that grow on the surface of the rock in their growth and in their decay, when dead, form acids that also unite with the rock to alter and soften it. Then when the rain pounds down on the rock or little streams flow down its surface the soft parts are washed off, so exposing deeper layers to such weathering agencies. At the foot of a steep cliff there is usually found quite a bank of such particles of decomposed rock—a bank of soil.

The rock on a hill becomes very hot in summer days as you know if you put your hand upon it. After sundown it cools off quickly and is likely to crack just as a glass bottle cracks if you pour cold water into it when it is hot. The sudden change of temperature causes unequal contraction (or expansion) and so makes the cracks. Then water fills these tiny cracks and when it freezes it expands and makes the cracks larger. Roots of shrubs and trees in such cracks help to widen them. So the rock is gradually broken into fragments, some large, some small. The water from heavy rains or melting snows will wash the smaller particles down the steep hillsides

and as they go bouncing along, they break into still smaller bits and also break little bits from the rocks they strike as they bound. If they are carried into little streams and by them into larger rivers, the process continues as they are rolled along the stream bed; they grind against their fellows and against the rocky bottom until the sharp edges and corners are worn off and they become rounded pebbles. In time even these are ground to rock powder or soil. Then as plants and animals live in such soil and die, generation after generation, their decomposing remains add the humus which makes some soils so black, like that of the beech-maple forest, or of a well-fertilized garden.

Along the shores of the oceans and lakes the rock fragments are frequently washed into the water and are mauled around by waves and currents until they are ground up into soil. This is often washed up on the shore as beds of sand or mud. On high mountains and in polar regions great slow moving streams of ice, called glaciers, grind over the rocks and pulverize them to soil. The river that comes from the melting front of such a glacier is usually very muddy because it is carrying so much soil.

In some parts of the country these agencies of soil formation and transportation have built very deep layers of soil, so one must dig down through the soil many feet, even hundreds of feet, to get to the bed rock. In the mountain regions, however, the soil is often very thin, for it washes off about as fast as it forms.

A LITTLE JOURNEY TO THE ROCK PILE OR TO THE STONE QUARRY

SUCH ponds as we have studied in the earlier sections are usually filling up more or less rapidly. The rains and little streams running into them from the surrounding hills bring in a good deal of dirt. In the quiet water of the pond it has a chance to settle to the bottom. If there is an outlet to the pond, this stream is usually quite clear and free from sedi-

ment. Then, too, the water plants, reeds, and rushes that grow in and around the margin of the pond die down each year, sink underneath the water, and form a mass of decaying vegetation. The second year's growth is piled on the first and so there gradually accumulates much vegetable débris, more or less mixed with earth.

HOW SEDIMENTARY ROCKS ARE FORMED

There are in such ponds thousands of snails, clams, and other animals with more or less mineral in their shells or other skeletal parts. When such animals die, this mineral material falls to the bottom and adds to the increasing accumulation. Thus the pond or lake gradually fills up. It becomes shallower and smaller in area as the marginal parts gradually rise above the level of the water, through the accumulation of the vegetable débris. The pond changes to a swamp and finally to a prairie or possibly a forest.

The same sort of filling process is going on in the large lakes and in the ocean. Rivers bring down enormous quantities of soil which they carry as sediment. They bring down gravel, even very coarse gravel, which is rolled along the bottom in swift streams; and they carry much mineral matter dissolved in the water. Thus the Mississippi River carries into the Gulf of Mexico every day over a million tons of such materials. The coarser matter is dropped at or near the mouth and builds up the delta. The finer stuff is carried far out to sea to sink to the bottom in the quiet waters of the ocean. The wave action along the shore wears down the bluffs and rock cliffs, and pulverizes the material of which they are composed. This material is also carried out to sink in the quieter depths. So the ocean gradually fills up.

In some places, as for instance at the mouths of great rivers, the process is going on very rapidly. As this material accumulates through hundreds, even thousands of years, the lower layers of the mud or sand are under very great pres-

sure, due to the weight of the layers that overlie them. These deep layers are baked by the increasing heat of the earth's interior. When a deep well is bored or a deep mine is dug, it is found that the temperature rises one degree for every fifty feet of depth, beyond that point of constant temperature not reached by the effects of the sun's rays. If such beds of mud, therefore, should pile up to a mile or two in thickness, it is evident that the lower layers would be intensely heated. Where such great deposits of sediment are accumulating, their weight is so great that they tend gradually to depress the rocks below them, bending them under their weight. Thus it is possible in a sea which remains fairly shallow, for mud and sand beds to accumulate to a great depth.

Under the influence of such enormous pressures and high temperature the sand or mud may gradually change to rock. It is by just such a process of pressing clay together and then baking it that men make bricks, a kind of artificial rock. It is easy to understand, therefore, how rock can be made in nature by a similar process.

When beds of sand are thus transformed to rock by heat, pressure, and the cementing action of materials dissolved in the water, the rock that is formed is known as sandstone. One can see that it is made up of little grains of sand. The mud deposits are really clay deposits, and when they transform into stone, they make shale. This is a rock that can be broken up into thin flakes. When the sediment is largely composed of the broken-up shells and skeletons of animals like the skeletons of corals, the stone that results from its solidification is known as limestone.

In certain regions of the ocean, coral reefs lie along the shores for hundreds of miles. The little coral animal absorbs out of the water the lime which the water holds in solution and uses it to build its skeleton. When the animals die, the wave action breaks up the skeletons and so forms the sediment. In many parts of the ocean, especially in the warmer regions, there are millions of tiny swimming animals with



Group of student teachers, The University of Chicago, decoding the rocks.
Every rock pile contains messages of interest

shells that are made of this same lime. When they die the shells drop to the bottom to form beds of sediment that may in time transform to rock. Most chalk is composed of such tiny shells.

Limestone, sandstone, and shale are very common rocks that make up the bed rock underlying the soil over very wide areas of the United States. Such rocks, since they are made out of solidified sediment, are known as sedimentary rocks. They are always formed under water. Wherever we find them, we know the sea or a great lake once covered that region while they were being formed.

One often finds in such rocks the more or less perfect shells, bones, or other parts of animals that died and whose remains sank to the bottom to form part of the accumulating sediment that was later changed to rock. If one lives in the neighborhood of limestone or sandstone quarries or near coal or other mines that are dug through deposits of these sedimentary rocks, it is interesting to hunt over the rock piles for such fossils. One may find perfect shells, bones, teeth, even complete skeletons, and often the delicate tracery

of the leaves of plants or the fruits of plants. It is from such fossils that we learn about the animals and plants that lived long ago when the rocks were forming.

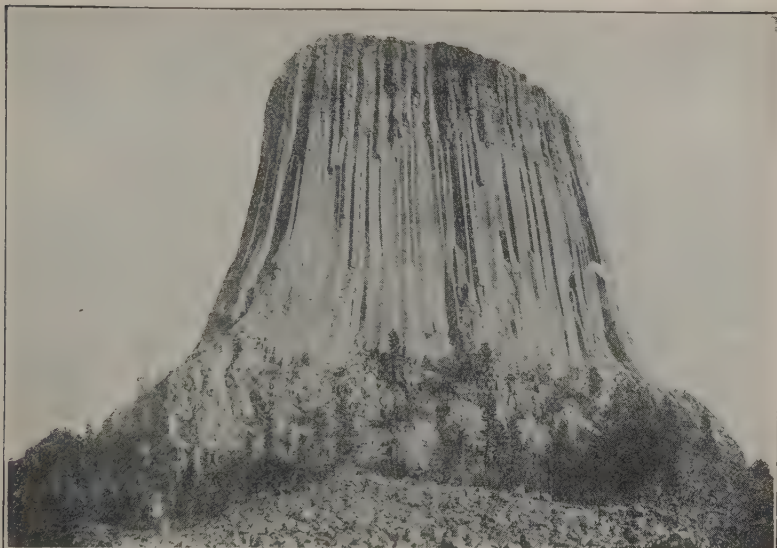
THE IGNEOUS ROCKS AND THEIR FORMATION

When a volcano erupts and pours out its lava, this lava gradually cools and forms rock. Such rocks are known as igneous rock because they are the result of the cooling of molten material. Sometimes lava instead of pouring out of the throat of the volcano wells up through cracks in the earth and spreads out over the surrounding rocks. In the earlier history of the earth such outpourings of lava from cracks that were miles or even hundreds of miles long were quite common. In fact, scientists think that the rocks that made up the surface of this early earth were all such igneous rocks. It is out of the sediment worn away from such rocks by the agents of erosion that the earliest sedimentary rocks were formed.

When a great sheet of such molten material is poured out on the surface covering perhaps hundreds of square miles, the light materials naturally float toward the top. When the molten material cools, there are found different sorts of rock from the top of the cooled mass down toward its bottom. We have learned a great deal about such igneous rocks where deep mines have been dug through them, where rivers have cut their deep canyons through them, and where they have been worn away to their deeper layers by glaciers and the other agencies that gradually tear down the rocks.

There is a great deal of gas contained in lava and this, of course, bubbles up through the melted stuff like the gas in soda water, to make a froth at the top. When the lava has cooled, this frothy stone is known as pumice. Frequently it is light in color and is, of course, very light in weight because it is so full of holes. Sometimes children think it is petrified sea foam. This of course is an incorrect notion.

When the lava cools off rapidly as it does in its upper



Photograph by Darton

Courtesy, U. S. Geological Survey

Tower of igneous rock. The softer, less resistant rocks which covered and surrounded these columns have been worn away

layers because these layers are close to the cool air, it makes a glassy rock that is known as obsidian. When this rock is broken the surface is curved, like a clam shell. The Indians of the West used to chip this obsidian and shape out of it their arrow and spear heads. The deeper layers of lava as they cool crystallize; that is, they form into little particles that are bounded by smooth plane surfaces. The shapes of these crystals are different for the different minerals that compose the cooling lava. The deeper the lava, the slower it cools and the coarser are the crystals that are formed.

There are a great many different kinds of igneous rock, depending on the kind of minerals of which they are made and the coarseness of the crystals. One of the most familiar of these igneous rocks is granite. The essential minerals in granite are quartz and feldspar. Quartz is the mineral or substance that makes the grains of sand. Quartz crystallizes in little six-sided prisms with a six-sided pyramid at each

end of the prism. The crystals when very clear are sometimes sold as "Hot Spring diamonds." The quartz is more frequently found in an uncrystallized condition, just massive quartz. When quartz is broken it has an appearance very much like broken glass. The broken surface is curved like an eggshell.

The obsidian described above is merely one form of quartz. Quartz varies greatly in color; it may be clear and glassy or milky, and almost any color, even black. The color is usually due to other minerals that are dissolved in quartz. Iron ore dissolved in quartz gives it a red color. Such red quartz is known as jasper. Other substances give other colors. Quartz crystals that are violet or purple in color are known as amethysts. Quartz is so hard that it easily scratches glass. It is nowhere nearly so hard, however, as the diamond, which is the hardest mineral known. The diamond, therefore, easily scratches quartz.

Feldspar, which is also found as a part of granite, is a mineral that is not quite so hard as quartz. When it is broken the fragments are bounded by smooth surfaces. The opposite sides of each fragment are parallel to each other, not at right angles, however, as in a cube, but at angles that are a little bit less or more than right angles. The feldspar in granite is usually rather light in color, flesh color or pale yellow, although it may be quite reddish.

While quartz and feldspar are the essential elements of granite, many granites contain other minerals. One of the commonest is mica. This flakes into thin elastic flakes. Mica is so soft that it can be scratched with a knife blade. The little particles of mica reflect the light almost like a mirror. Sometimes granite contains a black mineral that is hard and is found in slender six-sided crystals, looking somewhat like bits of the lead of a lead pencil. This mineral is hornblende.

While the bed rock of much of the central United States is limestone or sandstone, the earth that overlies the bed rock in the regions north of the Ohio and Missouri rivers contains many boulders of igneous rocks brought down by

the glaciers that at one time covered the northern part of the United States. You will probably find several kinds of granite, if you crack open some of the boulders found in the fields or along the roadsides. When granites are broken by frost, running water, or glacier action, and the particles are carried down to the lakes or oceans by the rivers, the little particles of quartz, being very heavy, will form beds of sand fairly close to shore. Feldspar is softer than quartz and is more easily ground up. Its particles make the mud or clay that settles in the deeper and quieter parts of the great lake or ocean.

METAMORPHIC ROCK AND HOW IT IS FORMED

There is still a third kind of rock known as metamorphic rock. Mountain chains are formed by the upfolding of the rock layers of which the earth's outer portion is formed. You have seen an apple, perhaps, that has gradually dried up. Its outer part is wrinkled. Mountain chains have valleys between them. Mountains and valleys form such great wrinkles on the earth. This is not always true, for in some cases the valleys are worn out by rivers and the ridges between the valleys stand up as hills.

When mountain chains are thus upheaved, the folding of the beds of rock is accompanied by terrific pressure and by the production of a good deal of heat as rock particle rubs on rock particle. Such pressure and heat transform rocks into new sorts. Sometimes where a mass of lava has welled up through a crack in the rock, the rock next to the lava stream has been altered by the heat of the lava. These altered rocks are known as metamorphic rock.

In such a way limestone is changed to marble, sandstone is changed to quartzite, shales are changed to schists, and granite is changed to gneiss.

Marble is composed of small crystals that glisten. Since it is made of limestone, it consists of the same material, carbonate of calcium. When a drop of acid is put on either

limestone or marble it decomposes the stone or causes carbon dioxide to bubble up through the drop of acid. Sometimes if you are in doubt as to whether a bit of rock is limestone or marble, you can put it in a test tube, cover it with acid and see the gas given off. In some very hard limestone it is necessary to warm the acid before the gas will appear.

Quartzite is hard, since it is made out of quartz. Usually you can see the little quartz grains indistinctly because they are partially fused. Like quartz, quartzite breaks with a rounded surface.

Schists are usually quite soft, often so soft that they can be broken with the fingers. They are flaky in texture and often composed very largely of one mineral. Thus there is one schist known as micaceous schist that is composed largely of mica.

Gneiss has the same minerals in it as has granite, but each little particle of the mineral has been pressed out by the pressure and these little flakes lie parallel to one another. This rock, therefore, has something of a stratified appearance.

THE AGE OF ROCKS

The rocks that man can get at compose only the thin outer portion of the earth. Mines have been dug more than a mile in depth. Some rivers have cut gorges a mile deep. Mountains have been upheaved and in the process the rock layers have been broken so that the faces of cliffs or canyons expose layers of rock for a mile or more in height, and yet, this portion of the earth so rendered visible is relatively small when we remember that the earth's diameter is about 4,000 miles. We can only guess at the composition of the earth's interior.

It is fortunate, however, that some sections of the earth's surface are made of the old igneous and metamorphic rocks, while others are made of the more recent sedimentary rock. Probably the more recent rocks have in many cases been worn away through long ages of erosion, so as to expose

the earlier igneous rock in those areas where such rocks now are at the surface. Man is able, therefore, to see samples of the rocks of many ages and so can calculate by the thickness of the upturned edges of the sedimentary rocks about how thick the successive layers of sedimentary rocks that overlie the older igneous rocks would be, in case he could dig down through the undisturbed series. He can also measure roughly the rate at which beds of sand and mud are accumulating on the ocean floor and how much they are compressed as they transform to rock, and he can guess approximately how rapidly rocks have formed. Knowing roughly the thickness of the sedimentary rocks, he can find out how long it has taken them to form.

Thus the Niagara limestone which is the bed rock in the Chicago region and over a fairly wide area in the northern states was probably formed not less than 500,000,000 years ago. It gives one a strange feeling to go into a limestone quarry in this region and pick up a fossil shell and realize that he is holding in his hand an animal that lived and died 500,000,000 years ago on the spot where Chicago now stands.

A LITTLE JOURNEY AT NIGHT TO LOOK AT THE STARS

BUT now you ask, perhaps, what was our earth like before these sedimentary rocks began to form and where did it come from to begin with? These are puzzling questions, but scientists are bold enough to try to answer them. When you go out at night, you see the sky studded with brilliant points of light, the stars. If you should patiently count the stars you see, you would probably count some 3,000 or 4,000. If you could suddenly step around to the opposite side of the earth, so you could see the night sky there, you would count about as many more. Now each of these stars is a sun somewhat similar to our sun. Our sun looks very large to us because it is so near. It is only 93,000,000 miles away. That is so near that it takes light only about nine minutes

to come to the earth from the sun. Light travels at the rate of 186,000 miles per second. That is about seven and one-half times around the world every time the watch ticks. The nearest other star to us is so far away that it takes light four years to reach the earth from it. Many of the stars are so far away that it takes light thousands of years to reach the earth from them. As stars go, our sun is a small one. We have measured the diameter of stars that are millions of times as large as our sun.

When a powerful telescope is used, the astronomer sees many, many more stars than can be seen with the naked eye. In fact, there are probably 500,000,000 or more in this group of stars of which our sun is one. It would be strange indeed if our sun were the only one of the stars that had planets moving about it. If most of them do have such planets, what a large number of bodies are moving around in space! Not only do the planets of our solar system move around the sun, but the sun itself with all the planets is also moving rapidly through space. So undoubtedly are the other stars.

HOW OUR SUN AND PLANETS FORMED

It would be a wonder if every once in a while a couple of the bodies in such a complex system did not collide. Astronomers tell us that probably this does happen. The heat produced by the collision is so great that the bodies blaze out as a bright new star. But even more common must be the occasions when two of these bodies come near colliding. When that happens, they tear each other into bits because each one is torn by opposing forces, the attraction of the body that has come so close and the momentum of the movement of each in its own pathway. It is supposed that our sun and the planets that now revolve around it with their attendant moons began as a result of such a smash-up. The largest fragment resulting from the disaster, perhaps itself thousands of miles in diameter, became the nucleus of the sun. Other smaller but still good-sized fragments became

the nuclei of the planets. Each of these fragments then began moving in a new orbit. Since the biggest mass exerted more force than the smaller ones, the latter all revolved around the former. But the nuclei of the planets also forced some of the smaller masses to revolve around them as moons.

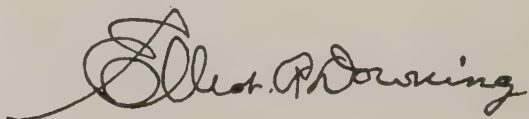
Many of the very small bits were so forcibly attracted by such large masses as the nuclei of the sun and the planets, that they were drawn directly down upon them. So there undoubtedly rained down onto the nuclei of this, our early earth, hordes of these fragments—planetesimals, as they are commonly called. Whenever the pathway of one of these fragments brought it sufficiently near to the earth so that the pull of the earth was greater than the force driving it on its way, it was pulled down and became a part of the earth. Thus the original nucleus of the earth grew as these smaller masses were piled upon it.

This process is still going on. When one of these tiny masses is pulled toward the earth it comes with bullet-like velocity. It enters our air and the friction between it and the air is so great that it is heated until it glows, leaving a trail of sparks behind it, as it burns its way earthward. Such things we call meteors or, improperly, "falling stars." Most such bodies that are now attracted toward the earth are small, and many burn up completely before they reach the surface of the earth. Sometimes a large one falls onto the earth and buries itself in the soil. Such meteorites have been dug out and are to be found in museums. The American Museum of Natural History in New York City has one that weighs over a thousand pounds. In Arizona there is a great hole not only in the soil but in the rock below the soil where a huge meteorite is supposed to lie buried. This hole is more than a mile in diameter and about six hundred feet deep from its rim to the bottom. Just how large this meteorite is, no one knows, but it is estimated that it weighs five million tons.

As the earth thus gradually increased in size, its gravita-

tional pull became more powerful and it could draw down to itself some of the lighter materials, like water vapor, oxygen, and nitrogen. It thus began to accumulate an atmosphere. Gradually the water vapors in the atmosphere could condense and form little ponds and lakes in the irregularities of the surface. These grew larger. Finally many of them merged to form the oceans. No sooner had lakes and oceans come into existence than they began to tear up the materials of the growing earth to form the sediments out of which the earliest sedimentary rocks were made. The other agents of erosion, rivers, winds, and frosts added their labors to wave and ocean currents. And so the earth's surface was gradually shaped into its present form.

There has been sketched very briefly the way in which scientists nowadays think our solar system began and the ways in which it has gradually developed into its present condition. As you read more and learn more about science, you will learn more of the details of this, perhaps. It is enough here, if we can get a picture of the main events.

A handwritten signature in cursive script, reading "Elbert P. Downing". The signature is written in dark ink and is positioned centrally below the main text block.

IDENTIFICATION-APPRECIATION SCIENCE SECTION



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IDENTIFICATION-APPRECIATION SCIENCE SECTION

MAN prides himself on being different from other animals because of the fact that he possesses reason. He prides himself that he behaves as a reasonable being. In order that that behavior may be really reasonable, man must have knowledge of the parts of his environment with which he comes into contact. Real appreciation is based in a large measure upon knowledge, though this does not imply that appreciation always goes with knowledge.

It is partly in the hope that the readers of THE CLASSROOM TEACHER may agree with this sentiment that this Identification-Appreciation Section is written. We appreciate and understand best those of our friends whom we know best, and even many whom we think are our enemies prove to be our friends when we get to know them better. Even if they do not show signs of deserving our friendship after long acquaintance, we know best how to avoid or protect ourselves from injury from those enemies whose habits are an open book to us. Not infrequently we can turn their destructive habits to our advantage in contending with other enemies. While this may seem to be a selfish attitude, it is a part of the joy of life for man to be master of the circumstances in which he must make his way, and if he uses his intelligence not only for his own benefit but for the benefit of

his fellow men and of helpless, harmless creatures, he is indeed living a full and useful life. To reiterate, the attainment of this ideal may probably best be made through knowledge of the forces with which man lives. Justice may be pictured as being blindfolded, but all of us know of occasions when we felt that justice might really serve better with its eyes wide open and all of its senses exercised in collecting evidence to aid in making a just decision. Too many people in the past have accepted all things as good or all things as bad, simply through blind faith or because it was easier to accept what was told them by others than to let their own senses tell them better.

In preparing this section, the writers have attempted to present information about types of creatures and plants which will give the reader a reasonable picture of the greater groups, both from an economic and from an esthetic standpoint. The representative species were selected in the hope that the plants and animals themselves will be found by the reader and used as sources of study, with the book material to serve as assistance in making observations.

Species of animals and plants have been selected which will help one in studying and appreciating such varied types of country as waterways, meadowlands, forests, deserts, and similar ecological units. This opens up one of the most interesting fields of study in connection with understanding why and how certain species of plants and animals find it possible or convenient to confine themselves to particular parts of the earth or types of country. Knowledge of this tendency of plants and animals to live in more or less definite types of country has been most useful in interpreting the past through the finding of fossils in earth now much different from what it may have been in past ages. Aside from its academic importance, such knowledge has proved useful from an economic standpoint. Not a few fossils are used as keys in guiding the activities of those boring for oil, for example.

Care has been taken to present among the animals a variety of species representing different food habits. Knowl-

edge of the food of a given animal is most important in establishing its economic status, since it is by its food that we judge it largely. One cannot safely, for example, bring down his wrath on the heads of all snakes simply because one species is known to be undesirable. Such blind behavior would defeat our very purpose and make us the laughing stock of those who happened to know that other snakes on which we might inflict punishment were really the worst enemies of those against which we might have a just grievance. There are similar examples which might be drawn from any of the other big groups here considered.

Where possible, the identification characteristics which would help one to identify in the field the species mentioned are given in preference to minute details which might be used in connection with a dead specimen in a laboratory. In addition, the pictures, particularly of the birds, should take the place of any lengthy verbal description which might be given. Color characters and the ways the various creatures feel to our touch are given in cases in which these are significant and only half-tone illustrations are available.

The fish section is worthy of study because man has generally failed to appreciate the enormous potential resources of our waterways. We have blindly and foolishly destroyed possible sources of food supply simply because we were concerned with disposing of refuse in the quickest possible way, or else we have fished streams and waters until certain species have been entirely exterminated from them. There is no reason why, if we would use half as much judgment in connection with our aquatic sources of food supply as we have with our cultivated crops, we should not enjoy the abundance experienced by our ancestors. Unfortunately, however, humans do not think about these big problems as nations or as large units, but generally dissipate what energies they have by doing, as individuals, what is most convenient at the moment and letting the future take care of itself. This certainly is not appreciation in its highest sense.

The plant section is designed not only to interest one in

plants and to help one understand something of their classification, but also it is hoped that it may lead to greater appreciation of plants as members of plant societies. Plant life is of course basic to all animal life because without plants all animals would starve. Plants serve another function in assisting to hold back floods, and in addition they provide us with considerable shelter, warmth, and beauty. Many people do not seem to think of them as living things, probably because they have not taken the time or effort to give them any attention. It is possible that any of these lines of experience may be opened up and developed through using the plant-study section of *THE CLASSROOM TEACHER*.

Invertebrate animals are so abundant and perform such a variety of services that it seems strange that it should be considered a disparaging remark to accuse one of "having no backbone." Lands have been built, mountains have been changed, large animals have been forced into extinction, and many other seemingly difficult feats have been performed by invertebrates like those that are living today. We fasten our clothing with buttons of the shells of clams. We eat fruits that developed only because of the activities of certain insects and we are deprived of eating other food for similar reasons. Probably the invertebrates are the most significant animals in the world today. If we cannot control or direct their activities we shall be compelled to yield this earth to them. Surely creatures with such great possibilities are worthy of intelligent appreciation.

The reptiles and amphibians are more interesting and probably less appreciated than any other group of vertebrate animals. With them the just suffer repeatedly for the deeds of the unjust, and if man inflicted on his own kind punishment similar to that which he inflicts on reptiles and amphibians in general, none of us would be safe at any time. With the members of this group, too, we have been false to the pride which we take in ourselves as reasonable human beings. We have killed frogs by the hundreds when they had congregated for the purpose of reproducing their kind. Many times

we have done this simply for the lust of killing, not remembering that the creatures we were killing were the best of insect destroyers. Certainly reptiles and amphibians have a right to ask that we appeal to our reason in our treatment of them. They have not profited by appeal to any other sense. The slightest knowledge of the lives of most of these creatures, particularly of the amphibians, should be a sufficient argument to win them respect and protection. This, mind you, is not made as an appeal to sentiment.

Probably more has been done in an organized way to present the case of "Birds versus Humans" in a fair way before Judge Public Opinion than is the case with any other group considered in these sections. As our knowledge of the habits of birds has increased, our precautions for their protection have increased. Fortunately this increase in knowledge began to take rapid strides at the very time when many species of birds were beginning to vanish completely. No group of animals probably has responded more splendidly to reasonable human treatment than have birds, and the case was won through appeal to the public on economic, sentimental, and humane grounds. With the splendid illustrations provided in the bird section of this department, little difficulty should arise in understanding why it was so easy to appeal to the public for protection of birds for sentimental reasons, if for no other.

Undoubtedly as time goes on there will be a more concerted effort to have the public really understand the services performed by wild mammals. The inhumaneness attendant upon the use of steel traps is easily comparable with the inhumaneness attendant upon the production of aigrettes. Besides this somewhat sentimental appeal, there is the appeal to reason which comes with the realization that many of our best fur-bearers are also the best destroyers of mice, which, in turn, are the worst destroyers of our crops. In a way we are taking food from our mouths to put furs on our backs. Our laws, as they now generally exist, offer little reasonable protection for the rarer species. We trap as long as the season

lasts, whether there are few or many individuals of a species left and such behavior on our part is far from reasonable. Not a few communities are recognizing the economic value of the appeal of wild animals to tourists, and this has led to the establishment of many game preserves. The game sanctuary idea, which is rapidly gaining ground in the United States, is probably one of the most significant developments that offer possible perpetuation of a number of species. The popularity of such developments and the tendency of humans to go more regularly to the wilds to enjoy living things rather than to bring home dead things are most encouraging bits of evidence that we do differ from other animals in the possession of reason. But remember, genuine appreciation is based upon knowledge.

A handwritten signature in cursive script, reading "Elmer Palmer". The signature is written in dark ink and is centered below the main text block.

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BIRDS

BIRDS have appealed to the interest and the imagination from the most ancient times. They have been the source of themes for poets and the inspiration for the predictions of soothsayers of old. The sentiment toward bird study has increased during the past decade. The boy or girl who follows the birds afield, observes their habits, and listens to their songs gains a sympathy with nature that is invaluable.

Bird study in the elementary school should emphasize both economic and esthetic values. All over the diversified landscape, through the extensive forests, on the numerous lakes and streams, on the mountains, the prairies, and the plains, nature has provided an abundance and variety of birds which may be compared to a police force. The chief duty of these little policemen is to restrain the hordes of insects, which, if left unchecked, would in a short time take possession of the world.

Birds are nature's greatest checks on the inordinate increase of noxious weeds and harmful rodents. Someone has said, "Without the birds, not only would successful agriculture be impossible, but the destruction of the greater part of vegetation would follow." Thus, birds are one of our nation's greatest assets.

Not only do birds make life possible on earth but they add immeasurably to the joy of living upon it. Their form, color, and graceful motion delight the eye; their songs charm the ear; the annual cycle of life changes appeals to the imagination; their tireless industry in building homes and caring for young and their ceaseless search for food arouse wonder and respect for these little masters of the air.

Pupils should be familiar with the section on bird study given by Dr. Palmer in the department on Field and Laboratory Work in Nature Study, Volume V, page 409.

In the identification and study of birds a systematic out-

line aids greatly in arousing and maintaining interest. It also gives the pupil definite points for observation and research for each species studied.

I. Name of bird

II. Size

There are three bird "measuring sticks": English sparrow, 6 inches; robin, 12 inches minus; crow, 18 inches plus.

III. Appearance

A. Form

B. Color

C. Bill

D. Feet

IV. Flight

V. Song

VI. Habits

A. Nesting

1. Place

2. Materials

3. Eggs

B. Care of young

C. Food

1. Kind

2. How secured

D. Migration

VII. Relation to man

The birds selected for description are those which have a general range over most of North America. Those outstanding facts are given which enable the child to identify and appreciate the bird. Simple language has been chosen so that even very young children may glean information and derive enjoyment from independent study of these birds. Following the Bird Identification section there is a section entitled "How to Attract Birds," in which are given instructions for building bird-feeding stations and birdhouses for different birds, with suggestions as to what foods to provide for the various species.

AMERICAN ROBIN

PLATE 1

Planesticus migratorius

LENGTH: About 10½ inches.

RANGE: Breeds in Canada, Alaska, and in the United States to the Gulf states; winters from the northern states of the United States south to Guatemala.

Homesick colonists, longing for a glimpse of Old England, made this cheery thrush the namesake of their cherished bird. The robin is the friendliest bird neighbor. It is fond of the society of man. Wherever his hand clears the wilderness, the robin follows. No bird expresses emotion more clearly than this lovely songster. Joy, sorrow, contentment, anger are heard in its song. Clearly and loudly it sings at dawn; softly and tenderly it warbles at twilight.

The robin is a careful nest-builder. It is not so cautious in choice of a site. A window ledge, exposed to sun and shower, is as readily chosen as a protected branch of a tree. Such careless selection often brings grief to the birds. A little mud pool in garden or orchard may coax a robin to build near the house. It uses numerous pellets of mud in building the clay cup of its nest.

Included in the robin's diet are angleworms and many species of insects. More than half of its food is composed of fruits; the greater part is of wild varieties. Harsh names have been showered on this cheerful, confiding creature because of its fondness for cultivated fruits. It does much damage to olives and cherries, and fruit-growers can scarcely be blamed for disliking a bird that injures their crops. A good way to remedy this evil is to supply wild varieties that satisfy the robin's appetite. It devours with relish red mulberries, elderberries, black cherries, and chokecherries.

BROWN THRASHER

PLATE 1

Toxostoma rufum

LENGTH: About 11 inches.

RANGE: Breeds from the Gulf states to southern Canada and west to Colorado, Wyoming, and Montana; winters in the southern section of the United States.

From the topmost bough of a tree or bush the thrasher pours forth a melodious strain until the air resounds with exultant song. With upturned head and drooping tail it repeats, over and over,

the joyous refrain. The thrasher is one of the loveliest American songsters. Famed as a vocalist, it is called the mocking bird of the North. It does not possess the power of imitating other birds. Its song is composed of original notes. Unfortunately it sings for a few weeks only. After nesting season its voice is rarely heard.

It is partial to thickets. Nevertheless, it is a common bird of the barren jack pine plains. It is often found in sand dunes that skirt the edge of a lake. Sometimes it builds its nest on the ground; more often it selects a bush or low tree. Thrashers are devoted parents and guard their nest and young with utmost care. Should an intruder approach the nest, they fly about, constantly voicing their alarm and disapproval. They do not hesitate to attack the enemy, should he attempt to disturb the young. Thrashers defend and provide for their fledglings until they are almost full grown.

The thrasher secures much of its food on the ground. It thrashes the leaves under thickets and searches for insects. Grasshoppers, bugs, spiders, thousand-legs, and caterpillars form about half of the animal food. Beetles, including wireworms, May beetles, rice beetles, rose chafers, and fig eaters comprise the remainder. The vegetable food is composed largely of fruit, one-fourth of which is of cultivated varieties. The destruction of harmful insects overbalances the injury to fruit crops.

WOOD THRUSH

PLATE 1

Hylocichla mustelina

LENGTH: About $8\frac{1}{4}$ inches.

RANGE: Breeds in southern Ontario and the eastern United States west to the Plains; from the Gulf states north to central Minnesota and Wisconsin, southern Michigan, and New Hampshire; winters from southern Mexico to Central America.

When balmy days of spring have come and flowers begin to bloom, the wood thrush journeys northward. Its choice of haunt is a shady dell in quiet woodlands. There in the peaceful solitude, its harmonious flutelike song is sung from early morn till evening shadows fall. It is less shy and fearful than its cousins, the veery and the hermit thrush. Frequently, it nests in wooded areas of villages or parks. Occasionally, showing greater confidence, this gentle woodland bird builds its home near dwellings. A deep nest of twigs, leaves, sticks, and bark is lined with a thin shell of mud. This contains a few fine rootlets to hold three or four robin's-blue eggs.



Above, left to right, are shown the nests and eggs of the catbird and the brown thrasher. Below are those of the wood thrush and the robin. The center nest is that of the chickadee

A searcher of food on the ground, the wood thrush destroys many injurious insects. Grasshoppers, cutworms, caterpillars, ants, and beetles are favorite items of diet. A small percentage of fruit, largely of wild varieties, completes the fare. No bird makes a stronger appeal to nature-lovers and agriculturists than this bird of melodious song.

CATBIRD

PLATE 1

Dumetella carolinensis

LENGTH: About 9 inches.

RANGE: Breeds in North America from southern Canada to the Gulf states, west to and including the Rockies; winters from the Gulf states to Cuba and Panama.

The catbird is one of our most remarkable songsters. Like the mocking bird, it delights in imitating other birds. It sings at any time of day or during any kind of weather. Sitting high in bush or tree, it pours forth a melodious medley. Though small in volume, the song is full of sweetness unless interrupted by peculiar little catcalls.

This bird is partial to the cool shade of shrubbery and the tangled damp of thickets. There its well-hidden nest may be found. The nest is loosely woven of twigs, sticks, and grasses, and lined with fine rootlets. There are three to five greenish-blue eggs. The greater part of the food of nestlings is insects. These include injurious cutworms, leaf beetles, crickets, grasshoppers, and harvest flies. It is at this season that the catbird is beneficial to man. Later, when fruits begin to ripen, more than half the food of fledglings and adults consists of fruit. The toll on cultivated fruits is great. Strawberries, raspberries, blackberries, and cherries suffer most. As an insect-destroyer the catbird is of value to the farmer, but as "fruit thief" it has gained a bad reputation.

BLACK-CAPPED CHICKADEE

PLATE 2

Penthestes atricapillus atricapillus

LENGTH: About 5¼ inches.

RANGE: Resident in eastern Canada and the United States north of the Potomac and Ohio valleys.

The merry little chickadee is a nimble and active bird. Clinging to a branch, head downward, it pries into cracks and crevices for



PLATE I.

American Robin
Brown Thrasher

© Painted expressly for THE CLASSROOM TEACHER
Wood Thrush
Catbird



PLATE 2.

Brown Creeper
Golden-crested Kinglet

Screech Owl

© Painted expressly for THE CLASSROOM TEACHER

Black-capped Chickadee
White-breasted Nuthatch
Ruby-crowned Kinglet

insect eggs and larvae. Swinging from the top of a twig, it extracts tiny insects from bud and leaf. The chickadee is the little acrobat of the trees. It has a heart for any fate. It hustles about in stormiest weather, singing its cheery "Chick-a-dee-dee," and creeps to shelter only when ice encrusts the branches of trees and encases its food.

It is not difficult to get on friendly terms with the chickadee. It takes kindly to houses built for its need, though its natural home is a hole in a decayed tree stump or in a post. This tiny titmouse will become a constant visitor where suet is hung within its reach, or where canary seed and buckwheat are scattered. It does no harm to grain or fruit. Seeds of candleberry, poison ivy, hemlock, pine, and weeds comprise three-tenths of its food. The balance is composed of scale insects, caterpillars, moths, flies, beetles, spiders, and insect eggs. The good this little creature does in destroying eggs of the cankerworm moth, alone, cannot be estimated.

WHITE-BREASTED NUTHATCH

PLATE 2

Sitta carolinensis carolinensis

LENGTH: About 6 inches.

RANGE: Resident in southern Canada, the United States, and Mexico.

This busy gleaner of insect food travels restlessly among the branches and around the trunk of a tree, inspecting each hole and cranny. It chips off bits of bark with its long, strong bill; then it pierces deeply into the crevice where hidden insects lurk. The nuthatch has the queer habit of usually clambering down the trunk of a tree headfirst. Undoubtedly this aids it in discovering insects, larvae, and eggs that have escaped detection of woodpeckers and creepers. Nuthatches generally go in pairs, hunting food close together. They carry on a nasal conversation of "Quank, quank," "Yank, yank," while feeding. They are fearless little creatures. They will stop to look at anyone who quietly approaches. It is during nesting season only that they are retiring.

The nesting site is in a woodland of oak or other hardwood trees. A natural hole is selected, and is excavated to suit the needs of the nuthatch. It is lined with feathers, bits of fur, hair, grasses, and strips of bark. The eggs number from six to nine. They are white, thickly spotted with reddish-brown and lilac.

One-half of the food of the nuthatch is composed of insects. It destroys many beetles, moths, caterpillars, ants, and wasps. Perhaps the only helpful insect eaten is the ladybird beetle. The small amount of grain that it eats is largely waste. Chestnuts, beechnuts, acorns, and other soft-shelled nuts make up the remainder of the food. The nuthatch wedges a nut in a crevice, then "hatches" or hammers it with its bill to crack the shell. From this peculiar habit it has acquired its common name.

RUBY-CROWNED KINGLET

PLATE 2

Regulus calendula calendula

LENGTH: About $4\frac{1}{4}$ inches.

RANGE: Breeds in southern Canada, Alaska, and the higher mountains of western United States; winters in the southern half of the United States and south to Guatemala.

A bundle of incessant energy is the little ruby-crowned kinglet. It flits restlessly from twig to twig of tangled thicket while it extracts insect life from bud and bark of tree or shrub. Its favorite haunt is dense shrubbery. During spring migration, it sometimes seeks the high branches of trees. Ruby-crowned kinglets travel usually in companionable groups of ten or more. They chatter loudly, "Tsee, tsee, tsee," while they feed. One can approach very close to these busy little creatures; they are not shy. It is then that one can detect the flaming vermilion crest which distinguishes the male.

The spring song of this sprightly songster endears it to bird lovers. It is a clear, flutelike warble of many variations, and is surprisingly loud for such a tiny bird. Sometimes the ruby-crowned kinglet pauses in its industrious work among terminal branches to burst into ecstatic song.

The kinglet builds a beautiful cuplike nest which hangs on the twigs of trees. There are from five to ten eggs, whitish and spotted, and marked with pale brown.

The bird is mainly an insect eater. It varies its diet with elderberries, poison ivy, poison oak, and a few weed seeds. Wasps, bugs, flies, beetles, tree hoppers, and leaf hoppers comprise a large share of the food. It does most good in destroying plant and scale insects which damage fruit crops. Small in size but great in industry, this tiny bird is a great aid in destroying pests of vegetation.

BROWN CREEPER

PLATE 2

*Certhia familiaris americana*LENGTH: About $5\frac{1}{2}$ inches.

RANGE: Breeds in southern Canada and southern Alaska, and in the United States south to Nebraska, Indiana, and the mountains of North Carolina; winters throughout the United States.

The brown-streaked plumage of the creeper is so like the bark of the trees on which it spends much of its life that it generally escapes detection. It has a peculiar habit of feeding. It alights on the trunk of a tree near the base. Then it creeps up spirally, in little bounds or "hitches." Rarely does it creep to the top of a tree or explore the branches. When it reaches the main limbs of the tree, it flies to the base of a neighboring tree and repeats the spiral performance. Only occasionally does it climb straight up the side of a tree. As it flies from tree to tree it utters, "Screeep, screeep." It constantly searches for food in the cracks of bark. The sharp, slightly curved bill serves well in extracting eggs and larvae of insects. The long stiff tail supports the creeper in its ascent on the tree. This modest bird feeds frequently in company with two or three other creepers. Sometimes it associates with nuthatches, downy woodpeckers, and chickadees.

The brown creeper cleverly hides its nest between the trunk of a tree and a strip of loose bark. It is a small cup of dried grasses, lined with plant fibers and shreds of bark. Since the creeper prefers a tangled swamp for its home, it can rear its young with little disturbance. It is largely an insectivorous bird. It devours myriads of ants, wasps, plant lice, and plant scales. It is also destructive to small moths that are injurious to fur, clothing, and plant life. Its check on injurious insects, through destruction of eggs and larvae alone, makes the creeper a desirable bird.

SCREECH OWL

PLATE 2

Otus asio asio

LENGTH: About 9 inches.

RANGE: Resident in the southern part of Canada, in the United States, and in the northern part of Mexico.

The little screech owl selects a convenient nook for its home in an orchard, a grove, or a thicket. Its favorite haunt is an old apple

orchard where hollow limbs offer it secluded shelter. There it may safely retreat from pestering jays and mobs of birds that are ever ready to attack it. Though owls have little difficulty to see by day, they are drowsy and inactive. Not until after sundown are they alert and wide-awake. It is only at night that their tremulous call may be heard. The sound is not so much a screech as a weird, mournful wail.

Screech owls remain mated for life. If left unmolested, they become permanent dwellers in a favorite locality. They may be encouraged to nest near dwellings. They eagerly try a deep box placed in a sheltered nook where sunlight cannot penetrate the nest cavity. Four owlets are generally reared. They may be red or gray, for screech owls have two color phases.

These owls feed upon house, field, and meadow mice, snakes, crayfish, scorpions, and earthworms. They are also highly insectivorous. Grasshoppers, crickets, ground beetles, and caterpillars are their favorite insects. Sometimes they feed upon birds; this most often occurs when other food supplies fail. During warm spells in winter, the screech owl catches numbers of mice and other prey and stores them up in a hollow tree for use during colder weather. Frequently enough food is found in these larders to bridge over a period of a week or more. Fortunate is the farmer or fruit-grower who has screech owls as permanent tenants, for they destroy many of his worst pests.

GOLDEN-CRESTED KINGLET

PLATE 2

Regulus satrapa satrapa

LENGTH: About 4 inches.

RANGE: Breeds from northern Keewatin, southern Alberta, southern Ungava, and Cape Breton Island south in Rocky Mountains to northern Arizona and New Mexico, and to Michigan, New York, and the mountains of Massachusetts, and in the higher Alleghenies south to North Carolina; winters from Iowa, Ontario, and New Brunswick to northern Florida and Mexico.

This tiny, industrious sprite is a mere shadow of a dusky bird as it nervously flutters among the terminal branches of trees. Except the humming bird and winter wren, it is the smallest of our birds. Like its cousin, the ruby-crowned kinglet, it flits incessantly among the branches, exploring twigs for insects that lie hidden beneath

the scaly bark. So active is this little creature that it is almost impossible to detect its distinguishing mark. Only when in its acrobatic performance it hangs head downward can its flaming crest be seen.

The golden-crested kinglet is no wandering minstrel like the ruby-crowned kinglet. It can lay no claim to extraordinary musical ability. Its charm lies in its cheerful, sprightly chirp and its lively little song. "Teezee, teezee, teezee," it sings in ascending scale, which ends in a tittering warble. This dainty feathered mite braves severest weather; it endures rigorous storms and low temperature when food is abundant. Bits of suet tied to the branch of a tree will often induce it to remain near habitation.

The nest of the golden-crested kinglet is unusually large for so small a bird. The kinglet lays more eggs for its size than any other bird. The nine or ten brown-speckled, cream-colored eggs are placed in a hanging nest in a cone-bearing tree. Moss, bits of inner bark, and fine rootlets, well woven together, make a warm cradle for the young birds reared in a cold region.

This kinglet, too, is mainly insectivorous. It vigorously destroys plant lice and scale insects which do great harm to orchard trees. It is this little and insignificant bird that most successfully attacks and holds in check these foes of horticulture.

KINGFISHER

PLATE 3

Ceryle alcyon

LENGTH: 11 to 14½ inches.

RANGE: Breeds from northwestern Alaska and central Canada south to the Gulf of Mexico; winters from British Columbia, Illinois, and Virginia south to the West Indies and the Amazon Valley.

The kingfisher's call is unlike that of any other bird. It is a vigorous, prolonged, harsh rattle. As the fisher screams from pond or stream, it warns intruders to "keep off." It is the fisherman of its beat and it allows no trespassing. On a stub in the water or an overhanging bough, the lone fisher silently perches. Its body tilts downward. Its two-inch beak is ready to spear. Eyes scan the water for prey. Or, hovering over the place on rapidly moving wings the fisher waits to plunge on unsuspecting fish. Catching the glint of light on the scales of an approaching victim, it suddenly dives. Ris-

ing from the water, it flies with exultant rattle to a favorite perch. Here the captured fish is instantly swallowed or rapped against the perch until dead.

Often during nesting season the male carries a share of his catch to his brooding mate. Her home is in a deep tunnel in a steep bank of gravelly clay. In a large pocket at the end of the tunnel, five to eight white eggs are laid. Year after year kingfishers return to their carefully excavated home. The fish which compose the food are all small fry, such as minnows and chubs. Private goldfish and trout preserves undoubtedly suffer from visits of the kingfisher. The harm done to open streams, however, lies chiefly in the imagination of luckless fishermen.

BANK SWALLOW

PLATE 3

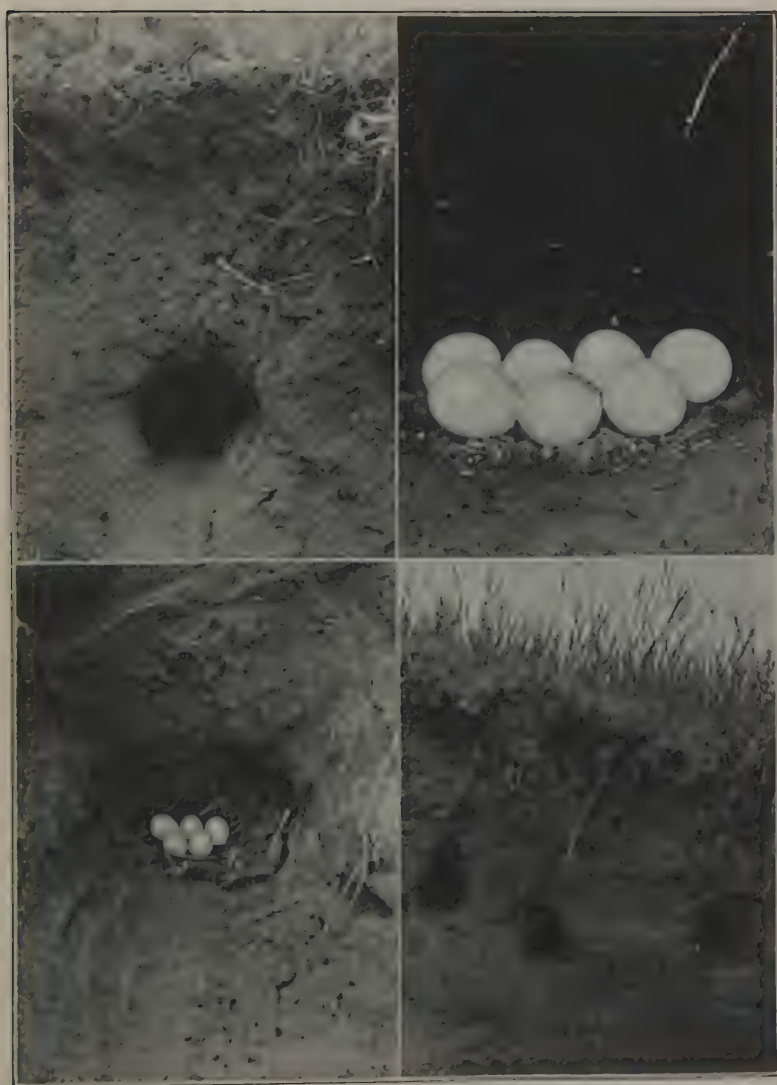
Riparia riparia

LENGTH: About $5\frac{1}{4}$ inches.

RANGE: Breeds from the central part of the United States north to the arctic regions; winters from the middle section of the United States south to northern South America.

The bank swallow is often seen accompanying others of its kin. It can easily be recognized because of its size. It is the smallest of the swallows. Its uniformly dusky gray back and the smoke-colored band across its chest are distinguishing markings. Bank swallows live in large colonies. The nests are placed in burrows in banks of loose soil which the frail little feet of the swallow can tunnel. They show a preference for banks that border streams and bodies of water. The perpendicular walls of such banks are often honeycombed with nesting holes. Sometimes a sand pit or a railroad cut is chosen. When this is far from water, the parents have great difficulty in supplying food for the young during a dry season. The burrows are from one to four feet in length. They are straight, curved, or elbowed, for they follow the course of easiest excavation for the swallow. Four to seven white eggs are laid in a chamber at the end of the burrow.

The bank swallow skims and circles and darts about in the air in pursuit of insects. It devours insects that abound in the vicinity of water. These include gnats, sand flies, small moths, and mosquitoes. Like all its relatives, the bank swallow rids the air of many troublesome insects.



Above, the entrance to the kingfisher's burrow, and the nest and eggs, shown in the opened burrow, below, the opened burrow of the bank swallow, showing the nest and eggs, and the entrance holes to the burrows of the bank swallows

BARN SWALLOW

VOLUME V, PAGE 410

Hirundo erythrogastra

LENGTH: 7 to 7½ inches.

RANGE: Breeds in most of Canada and in the United States except the South Atlantic and the Gulf states; winters in northern South America.

With ease and grace the barn swallow skims low over field and meadow or over the surface of a pond. It flies in a dipping and rowing motion, using its wings for oars and its tail as a rudder. Its conspicuously forked tail, with white spots, distinguishes it from other swallows. Almost constantly on wing from dawn until dark, it seeks tirelessly for countless insects. Swallows have sociable natures; they live peacefully and contentedly in colonies. High on a wall or a rafter of a barn or an old building, they place their bracket-like nests. These are built of pellets of mud mixed with straw and cemented together with the swallow's saliva. They are lined with grasses and an abundance of feathers to receive the three to five eggs to be laid therein. A bridge that spans a stream or a pier at a lake also offers a suitable nesting place. In the open wild, swallows seek caves or crevices in rocky cliffs.

The food of the barn swallow consists chiefly of insects captured on the wing. It devours many small dung beetles that swarm over fields and pastures; unfortunately, the bird eats a few species of insects that prey on other insects. Bees, wasps, and ants form more than one-third of the entire diet. The beauty and grace of the swallow, its cheerful twitter, and its help as an insect destroyer commend it to everyone.

PURPLE MARTIN

PLATE 3

Progne subis subis

LENGTH: About 8 inches.

RANGE: Breeds in southern Canada, the United States, and south to central Mexico; winters in tropical South America.

Originally, martins flocked together in hollows of trees or in caves. Long before civilized man lived in America, the Indian, a lover of nature, recognized the value of these cheerful and happy swallows. He attracted them to his lodge by fastening hollowed gourds to a pole. Early settlers followed the example of the Indian. They, too,



PLATE 3.

Purple Martins
Kingfisher

© Painted expressly for THE CLASSROOM TEACHER

Bank Swallow



PLATE 4.
Loggerhead Shrike
Cardinal

© Painted expressly for THE CLASSROOM TEACHER
Mocking Bird
Blue Jay

provided suitable nesting quarters. It is now more common to find martins nesting in bird houses than in wild, natural places. No birds live in greater contentment and happiness. The only discordant note that is ever heard in a colony of martins is the harsh chatter of an intruding sparrow. The flight of the martin is easy and graceful. It skims lightly along as it gives chase to numerous insects. Martins have unusual power of flight. If during migration they encounter a heavy windstorm, they huddle together. In wave-like motion they breast the storm. No sound is made until they reach the outer edge of the blast. Then they burst into grateful warbling twitters.

The martin feeds almost exclusively on insects. Wasps, squash bugs, clover-leaf weevils, locusts, and moths are included in the diet. The martin is not only an insect destroyer; its readiness to attack a crow or hawk that arrives in the neighborhood makes it of special value to the poultry raiser.

MOCKING BIRD

PLATE 4

Mimus polyglottos polyglottos

LENGTH: 10 to 11 inches.

RANGE: Resident from central United States southward into southern Mexico and the Bahamas.

No other bird has had more prominence in song and story than the mocking bird. It is a universal favorite and is one of the most cherished of native birds. It is among the first songsters of spring. In its southern range when winter weather is mild, it sings with as much spirit as it sings in spring or summer. The mocking bird revels in its power of song. With ruffled feathers and drooping wing, it sits on the topmost branch of a tree and sings a medley of musical strains. It has marvelous power of mimicry, and often includes in its melody the songs of other birds. It takes keen, roguish delight in teasing other birds by imitating their songs and calls.

The mocking bird is very trustful. If kindly treated it enjoys the society of man. It is a resident of garden, orchard, and roadside. Rarely does it choose a nesting site in woodland or forest. It builds its nest in any place that offers a support. Twigs, sticks, feathers, dried grasses, bits of paper, and rags are used. The four eggs are thickly spotted with reddish-brown. Less than one-fourth of its food is animal matter. It is fond of grasshoppers, cotton worms,

chinch bugs, and rice weevils. Its vegetable diet consists of seeds and fruits. Its appetite for cultivated fruits makes it troublesome in certain localities. Some orchardists offset the damage which might be done by providing enough fruit for harvest and for the mocking bird. Its place in the affection of those who know it has earned for it protection.

LOGGERHEAD SHRIKE

PLATE 4

Lanius ludovicianus ludovicianus

LENGTH: 9 to 10 inches.

RANGE: Resident throughout the southern half of the United States and Mexico; occasionally breeds in northern United States and in southern Canada; winters in the southern half of the United States and Mexico.

Not until the frost is well out of the ground does the loggerhead shrike begin its journey northward. In plumage it is not unlike the mocking bird. The broad black stripe on the side of the head and the hooked bill distinguish the shrike. It is largely a roadside bird. It is often seen perched on telegraph wires or on a distended limb of a tree on the lookout for food. In a thick tree or bush will be found the nest of the shrike. It is a bulky mass of sticks, bark, and wool. There are from three to five white eggs in each brood, and one or two broods in a year.

The loggerhead shrike is largely an insectivorous bird, destroying many insects of field and meadow. It consumes grasshoppers, large beetles, spiders, and caterpillars, and varies its diet with field mice, shrews, moles, and lizards. It occasionally catches small birds, not infrequently English sparrows. The feet of the shrike are not adapted to hold its prey while it eats, so it corners its victim. Then it tears it apart with its curved beak. It is generally regarded a cruel bird for it often kills more than it can devour. Butcher-like, it impales its surplus food on a thorn or a barb. There it lets it remain to decay. Its method of luring small birds is to be despised. Hiding among bushes, it imitates the call note of a bird. When the unsuspecting victim comes in innocent response, the butcher bird pounces upon it and carries it away. Then with much flapping of wings it leisurely makes its "looping" flight to another place of vantage. Aside from its destruction of helpful birds, the loggerhead shrike is probably one of our most beneficial species.



Nest and eggs of the loggerhead shrike (left) and of the blue jay (right)

BLUE JAY

PLATE 4

Cyanocitta cristata cristata

LENGTH: About 12 inches.

RANGE: Resident in eastern North America west to the Plains and south from northern Canada to the Gulf of Mexico.

Handsome in appearance, this noisy, quarrelsome cockscomb has made for itself a bad name. It is not a friendly bird, for it dislikes the company of others. Bent on mischief, it bullies weaker birds, pesters owls, and plagues squirrels. During breeding season it robs the nests of other birds of eggs and nestlings with which to feed its young. Thus it deprives field and orchard of the aid of helpful birds. After robbing a nest or committing some other wrong it generally calls "Thief, thief," as if to direct attention from its own misconduct. But with its many unattractive traits it possesses some good qualities.

The nest of the blue jay is a well-built structure of compactly woven sticks, lined with finer material. The nesting site is in a tree, about ten to twenty feet from the ground. There are from four to six eggs of pale olive green or brownish-ash color, thickly spotted with cinnamon brown.

Grown jays seldom feed on bird life. Probably they do much good in destroying harmful insects. About one-fourth of their food consists of wood-boring and bark-boring beetles, scale insects, grasshoppers, moths, caterpillars, and insect eggs. The remaining three-

fourths is vegetable matter. Though some fruit and waste grain are eaten, jays show a preference for mast. This is the seeds of shrubs and trees, chinquapins, acorns, chestnuts, beechnuts, and others. By burying nuts the jay, no doubt, helps to reforest lands.

CARDINAL

PLATE 4

Cardinalis cardinalis

LENGTH: 8 to 9 inches.

RANGE: Resident in the United States west to the Plains and north to the Great Lakes and southern New York.

The cardinal is the aristocrat of songsters. His dignified and quiet bearing calls forth admiration. Rarely does he mingle with other species. Nor does he condescend to feed on the ground. His favorite haunts are lofty trees, tangled vines, and high thickets. Everything about him is stately. Even his song is a clear whistle of exaltation. "What-cheer, what-cheer," he repeats as he flies from one lofty crown of a tree to another. His plum-colored mate is also a delightful singer. Her tones are softer and more gentle. She builds her nest in a dense evergreen or a matted tangle of vines. The nest is a frail cuplike structure of fine twigs, rootlets, and grapevine bark. It usually holds three or four light green eggs, mottled with brown and lilac.

The food of the cardinal consists mainly of weed seeds and berries. But it also includes in its diet a liberal quantity of insects. Many of them are injurious kinds, such as potato beetles, boll weevils, cotton worms, and codling moths. Fortunate is the home that can attract the cardinal in winter. Then it eats, besides seeds, berries of red cedar, bittersweet, thorn apples, and sumac. Sunflower seeds and corn on the cob are the cardinal's favorite delicacies.

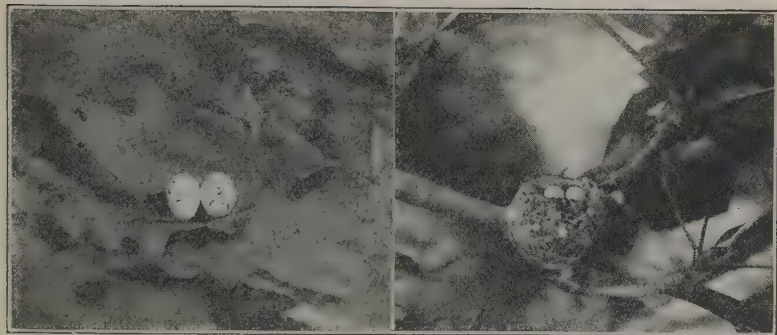
WHIPPOORWILL

PLATE 5

*Antrostomus vociferus vociferus*LENGTH: About $9\frac{3}{4}$ inches.

RANGE: Breeds from southern Canada south to the Gulf states, from the Atlantic coast to the Plains; winters from the Gulf states south to Guatemala.

"Whip-poor-will, whip-poor-will" is the rapid and vigorous call that comes from bushy field or the edge of woodland soon after sun-



Nest and eggs of the whippoorwill (left) and of the ruby-throated hummingbird (right)

down. Whippoorwill's day has begun, for it is a true night bird. It keeps to the woods by day and is never seen flying in the open like a nighthawk. Making short and low flights over fields, the whippoorwill pursues and captures insects on the wing. Between flights for food, it rests on some low bough or perch and repeats its snappy and emphatic notes. For nearly two hours after sunset whippoorwill continues to call. Then silence falls until a short period before dawn, when again it repeats its cry. On moonlight nights it calls throughout the night. Just before sunrise it seeks the denser woodland. Stretched lengthwise on a branch of a tree, it appears part of the very bark. Startled, it flies away in uncanny silence.

Two brown-mottled, grayish eggs are laid. They are placed on the ground or among leaves in woods or thicket. Insects that fly by night are the whippoorwill's chief diet. Large-bodied moths and May beetles are freely consumed. Whippoorwills are undoubtedly useful and entirely harmless. Great effort should be made to protect them as they are far from numerous.

RUBY-THROATED HUMMING BIRD

PLATE 5

Archilochus colubris

LENGTH: About $3\frac{3}{4}$ inches.

RANGE: Breeds in eastern North America west to the Plains, from the Gulf states north to Quebec and Saskatchewan; winters from Florida and Louisiana south to Panama.

This fearless little sprite is the smallest of all bird neighbors. It is the only hummingbird east of the Rockies. It is most numerous

where deep-tubed flowers abound. Columbine, bee balm, honeysuckle, trumpet flower, and cardinal flower are some of the flowers that nature supplies to attract the wee hummer. These blossom in succession and provide ample nectar throughout the summer. With rapidly whirring wings, the humming bird poises in mid-air before a blossom. It thrusts its long tongue into the tip of a cup and extracts nectar. The hummer is a friendly creature. It often seeks flowers in gardens and window boxes.

The mother bird is less attractive than her mate. She lacks the brilliant metallic red at her throat. Her industry makes up for lack of beauty. She alone builds the exquisite little nest. She fashions it of daintiest materials. Fern wool, silken threads of poplar and willow, and other fluffy plant fibers are used. The tiny cup is bound together with cobwebs. It is covered with gray-green lichens. So cleverly is it protected that it resembles a knot or a swelling on the branch upon which it is saddled. The nest is just large enough to hold two wee eggs, no larger than navy beans.

The hummer is not always friendly. It has a fiery temper. It engages in battle with another humming bird at the slightest vexation. Thrusting its needle-like bill at its opponent, it utters shrill little shrieks. Besides nectar, the hummer feeds on spiders and small insects, such as plant lice. As an aid to the farmer it is probably of no particular value. However, it is known to help in making seeds fertile by carrying pollen from one plant to another.

NIGHTHAWK

PLATE 5

Chordeiles virginianus virginianus

LENGTH: 9 to 10 inches.

RANGE: Breeds from central Canada south through the United States to the northern portion of the Gulf states and west to the Plains from Minnesota to Texas; winters in South America south to the Argentine Republic.

The nighthawk spends the day at rest, perched lengthwise on a limb or on the ground. Its plumage blends so well into its surroundings that it escapes attack from marauding hawks. As twilight approaches, it mounts into the open sky. Gracefully circling about, it courses for food. Lightly and quickly it flies. No insect escapes the keen eyes of this expert on wings. As it darts to and fro with astounding swiftness, it utters a loud nasal "Peent."



PLATE 5.

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Whippoorwill

Nighthawk

Ruby-throated Humming Bird
female (above) and male



PLATE 6.

Barn Owl

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Yellow-billed Cuckoo

Long after darkness has fallen, its cry may be heard, for the night-hawk is truly a nocturnal bird. Often while it flies it makes a sudden dive earthward. Before reaching the ground it rapidly circles around and mounts back into the sky. As the air rushes through the long wing feathers, a whirring sound is heard. This has been likened to the rush of air blown into the bung-hole of an empty cask. From this the nighthawk has received the name "nightjar." The nighthawk makes no nest, but lays its two mottled gray and white eggs on a flat rock, a bare knoll, or the gravel roof of a building.

The nighthawk is entirely insectivorous; it devours many varieties of insects. Mosquitoes, including the transmitter of malaria, are a prime favorite. Other pests destroyed are May, Colorado, and cucumber beetles; rice, chestnut, and cotton-boll weevils; squash bugs and moths of the cotton worm. During its autumn migration the nighthawk is often shot for food. It has then become plump with the insect pests eaten. Then, too, its darting flight makes it a tempting mark for sportsmen. This altogether useful bird is too valuable to be used either as target or as food. It deserves full protection.

BARN OWL

PLATE 6

Aluco pratincola

LENGTH: 16 to 20 inches.

RANGE: Resident in Mexico and in the United States north to New York, Michigan, Nebraska, and California.

Nocturnal in its habits, the barn owl is best known by its startling, wild, quavering cry. It keeps itself so well concealed by day that few persons have occasion to see it. Barn owls seek homes in a great variety of places; they show marked preference for hollows in trees. They often take deserted holes of woodpeckers. Miners have found them nesting in dark oreshafts. Ranchers and riders of the plains have startled these monkey-faced owls in sand banks or in rocky crevices, but in well-settled regions they keep close to dwellings. Frequently they nest in belfries or towers, or they seek a retreat in a barn or an abandoned outhouse.

The barn owl hunts mainly in the open. When darkness falls it flies about with almost uncanny silence. Slowly and noiselessly it skims over the ground, scanning the fields. Mice creeping forth are pounced upon. If the prey is too large to be swallowed at once, the

owl holds it down with its feet and tears it apart. Skin, bones, and flesh are all swallowed. Undigested parts are cast off by the mouth in pellets. Often in nests or about the roosts, a heap of such disgorged pellets may be found. The barn owl destroys many animals harmful to farm and orchard crops; pocket gophers, field mice, rats, and shrews are captured. It also devours many insects and a few birds. This owl is the most helpful bird of prey that flies at night. It would be a task to find another bird more useful to agriculture, and this valuable owl should be protected throughout its range.

YELLOW-BILLED CUCKOO

PLATE 6

Coccyzus americanus americanus

LENGTH: About 12 inches.

RANGE: Breeds in North America from southern Canada to the Gulf states; winters in the West Indies and South America.

Often on a cloudy day the weird cry of a cuckoo is heard. It is supposed that its plaintive "Kuk-kuk-kuk" foretells a rain. Hence, in many places it is called a rain crow. In habits and appearance, the yellow-billed and black-billed cuckoos are similar. The yellow underjaw, the reddish-brown wings, and the white ovals on the outer tail feathers distinguish the yellow-billed cuckoo. This quiet bird leads a secluded life. It slips noiselessly from tree to tree. Sometimes it sits almost motionless for a long time; then silently it makes its flight. It lives on the edges of woodland, in groves, orchards, parks, and even in shaded village streets. Unlike its European relative it does not lay its eggs in other birds' nests, but it is no artist at nest-building. A flimsy structure of little sticks is placed in a sheltered tree or shrub. Two to four greenish eggs are laid.

In its northern range, the cuckoo eats little or no fruit. Farther south it varies its diet with mulberry and elderberry. It is almost entirely an insect-eater. The insect food is composed largely of harmful kinds—webworms, tent caterpillars, beetles, grasshoppers, wasps, and flies. The cuckoo shows a special fondness for hairy caterpillars. During the season when tent caterpillars destroy the foliage of fruit trees, the cuckoo does an invaluable service. It pulls the little hairy invaders from their tents and devours six or seven in rapid succession. Perhaps no other bird is of greater help in destroying harmful insects.



Nest and eggs of the mourning dove (left) and of the bobwhite (right)

MOURNING DOVE

PLATE 7

Zenaidura macroura carolinensis

LENGTH: About 12 inches.

RANGE: Breeds in the United States and southern Canada; winters from central United States to Panama and the West Indies.

This shy, gentle bird is one of the earliest to arrive in the North. It comes about the time of robin and meadow lark. Quiet in feeding and silent in flight, it does not readily attract attention. To see it, one must follow its mournful "Coo-o." It favors the edge of woodlands that skirt open meadows. It hides its nest in an evergreen or in a second growth of oak. The nest is a loose platform of latticed twigs and sticks. Two white eggs make up the clutch. Shortly before nesting season, the male makes curious flights. He soars to a height of a hundred feet or more. Then he circles or spirals before tumbling to a perch.

Nestlings are fed in a peculiar manner. Their food is a cheesy substance. It is secreted in the crop of the parent bird. It is called dove's milk. The parent bird takes the beak of the nestling into its own. Then it pumps the food from its crop into the stomach of the young. The principal food of the mourning dove is weed seeds. All of these are useless; many of them are harmful. Almost one-third of the food is cultivated grain. Perhaps most of this is waste, picked up in the field. As the mourning dove helps to check the spread of weeds, it is of great value to the farmer.

BOBWHITE

PLATE 7

Colinus virginianus virginianus

LENGTH: About 10 inches.

RANGE: Resident east of the Rockies, from northern Florida and northern Texas and Colorado north to Maine, Ontario, Minnesota, and South Dakota.

This little quail keeps close to man in his agricultural movements. From stubble of field or fence post comes the clear whistle, "Bob-white, bob-white." Quails mingle in snug family parties or coveys, conversing in low twitting tones. Side by side they sleep, for protection, in a circular group on the ground, heads outward. Often in winter they bury themselves thus in the snow for warmth.

Bobwhite is clever at concealment. Its nest, hollowed in the ground under a bush or fence, is covered with grass or stubble. Eight to eighteen glossy white eggs are packed closely in the nest. They are placed with the points downward. A young covey just hatched will squat on the ground. So closely do they resemble the stubble and soil that they can scarcely be distinguished from them.

As the young are able to run soon after they are hatched, the whole family immediately forages for food; boll weevils, army worms, cutworms, and potato beetles are freely included. Any grain eaten comes from the stubble. Bobwhite rids the farm of great quantities of weed seeds. The value of this insect- and weed-destroyer has been overlooked in favor of its flavor. Unquestionably, bobwhites have been hunted too closely; they are beginning to thin out sadly in numbers. Fortunately, they can be raised in captivity. A wise farmer feeds these quail during the winter; he posts his land during the summer to prevent shooting.

RUFFED GROUSE

PLATE 7

Bonasa umbellus umbellus

LENGTH: About 17 inches.

RANGE: Resident in the eastern United States from Minnesota, Michigan, southern New York, and Vermont south to eastern Kansas, northern Arkansas, Tennessee, and Virginia, and in the Alleghenies to northern Georgia.

Ruffed grouse, the partridge of New England, is the finest game bird of the northern woods. Partial to hill or mountain country,



PLATE 7.

Bobwhites
male—female

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Mourning Dove

Ruffed Grouse



PLATE 8. *Winter scene*

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Horned Lark

Crow

especially to thickly timbered spots, it is a retiring bird. It was by nature confiding and trustful, but excessive hunting has made it suspicious. The ruffed grouse is famous for its drumming. By beating his wings rapidly in the air, the male makes a deep tattooing sound like the muffled beat of a drum. This may be to challenge other male grouse; it undoubtedly attracts the female.

The nest of the grouse is placed on the ground, often at the foot of a tree. A few dead leaves and wisps of grass hold the eight to twelve brownish-buff eggs. Young grouse, like chicks, can run about as soon as they are hatched. The female scratches for her brood like a barnyard hen. When suddenly frightened she utters a shrill call as a signal for the young to hide. Rapidly scattering, they seek the shelter of leaves and tangle, where they squat. Meanwhile, the mother feigning lameness, misleads the enemy. Not until a happy cluck reassures the motionless chicks do they leave their hiding places.

As winter approaches, the toes of the grouse are provided with a fringe of strong horny points. These act as snowshoes. In its northern range, during the bitter wintry weather, grouse often burrow in snowdrifts to keep warm during the night. In the milder regions and during summer they roost in small parties in trees. The food of the ruffed grouse consists largely of insects and wild berries during the summer. Beetles, apple worms, cutworms, grasshoppers, and other insects furnish about one-tenth of the food. Weed seeds are devoured in autumn. When snow covers the ground, buds, catkins, and leaves supply nourishment.

HORNED LARK

PLATE 8

Otocoris alpestris alpestris

LENGTH: About $7\frac{3}{4}$ inches.

RANGE: Breeds in Canada and throughout the United States except the South Atlantic and the Gulf states; winters in all of the United States except Florida.

Horned larks return to their haunts as soon as snow begins to disappear. They travel in large companies. Soon after their arrival they separate into small parties of less than a dozen. They are the first of migratory birds to nest. Frequently they begin to build their homes while snow still lingers. The nest is thickly woven of grasses and fibers. It is placed in a cavity on the ground which the birds

have hollowed out. The clutch contains three to five tannish-white eggs, thickly spotted with brown. When horned larks prepare to nest they begin to sing a twittering song. During breeding season the males often rise high in air, singing joyously as they ascend. When they are almost lost to sight they drop to earth again.

Horned larks are mainly seed eaters. They destroy the seeds of troublesome weeds such as sorrel, bitterweed, pigweed, and amaranth. Though only one-fifth of their food is composed of insects, they are active foes of pests. These include May beetles and their larvae, clover weevils, grasshoppers, locusts, billbugs, and chinch bugs. Horned larks have been accused of injuring grain crops, especially oats. Investigation has shown that where oats are consumed they are those that grow wild. On the whole, this lark should be included among the helpful birds.

CROW

PLATE 8

Corvus brachyrhynchos brachyrhynchos

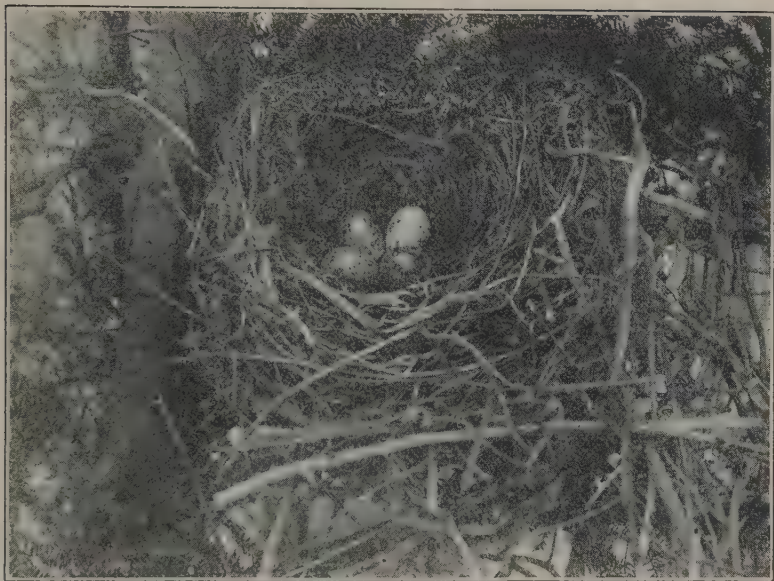
LENGTH: About 19 inches.

RANGE: Breeds throughout the United States and the greater part of Canada; winters in the United States.

There is scarcely a boy or a girl who is unfamiliar with the big black crow flapping its way over a field or resting in a tree top. No call of bird is better known than the harsh rasping "Caw" of the crow. Like its relative, the blue jay, the crow pilfers nests of wild birds and destroys many eggs and nestlings. It is sly and adroit at chicken-thieving. It often steals in the early morning, just before dawn. Sometimes, during the day, as if without guile, it sits quietly on a post or in a tree, awaiting an opportunity. Then it floats down noiselessly, snatches a downy chick, and flies away. Chickens on range are most often stolen.

The crow's nest is usually very large; it is made of sticks, grapevines, bark, sod, horsehair, moss, and grasses. It is placed in trees or in tall bushes rarely less than twenty feet from the ground. The eggs are pale bluish-green or nearly white with brownish markings.

The crow devours many insects, especially during the nesting season. Perhaps many of these are picked up after a storm has tossed them on the shore of a lake or a stream. A crow sometimes gorges itself on dead May beetles. Much of the animal food of the crow is composed of rabbits, shrews, mice, and snakes that have



Nest and eggs of the crow

died in the field. Other carrion is also destroyed. The greatest harm done by the crow is in pulling up sprouted corn. The kernel is then more palatable. It has become softened through contact with the moist soil, and the starch in the grain has begun to turn to sugar. This makes a dainty morsel for the crow. Perhaps the only method of combating this evil is in "oil-tarring" the corn. This imparts a disagreeable flavor to the young plant. Damage done to grain in the milk and in the shock is, perhaps, not very great. The crow has few habits to commend, but many to condemn.

WOOD PEWEE

PLATE 9

*Myiochanes virens*LENGTH: About $6\frac{1}{2}$ inches.

RANGE: Breeds from Florida to Newfoundland westward to the Plains; winters in Central America and northern South America.

The shy pewee is a bird more often heard than seen. Its plaintive "Pee-a-wee" is a familiar birdcall heard in every walk through the woods. It is a shade-loving bird and frequents woody regions, where



Nest and eggs of the wood pewee (left) and of the phoebe (right)

it prefers the high tree tops. This flycatcher can easily be recognized by the white bars on its wings. The wood pewee is a skillful architect. It saddles its nest on a limb of a tree. The structure is shallow and thin. It is built of fine grasses and fibers firmly interwoven and fastened with spider webs and lichens. So cleverly does it resemble the mossy limb that only sharp eyes can detect where it lies.

The pewee is mainly an aerial bird. It secures its food while in flight. As it deftly dashes about in search for insects, one does not associate this active bird with its sorrowful cry. It is not always mournful, for often after sunset it breaks into a twittering song. About one-half of the food consists of gnats and flies, including the house fly. Countless ants, grasshoppers, weevils, dragon flies, and beetles are consumed. The food habits of the pewee, like those of all flycatchers, are mainly beneficial to man.

PHOEBE

PLATE 9

Sayornis phoebe

LENGTH: $6\frac{1}{4}$ to 7 inches.

RANGE: Breeds in central Canada and in the United States west to the Rockies and south to South Carolina; winters from the South Atlantic and Gulf states to southern Mexico.

The trustful and confiding nature of the plain little phoebe makes it a welcome arrival. Bird-lovers eagerly await its emphatic call. It is the first of the flycatchers to arrive in the North, and it lingers

long after the frost-nipped air has driven most birds southward. Phoebe regularly return to their old nesting sites. Though they rarely use the old nest, they generally build in its vicinity. A well-sheltered nook is always selected. The phoebe shows a preference for water. It often builds under a pier or a bridge. Sometimes it chooses a protected ledge of a rock. Frequently it selects a beam or a rafter of a building. So fearless is it of man that occasionally it builds over a doorway that is in constant use. Soft substances are used for nesting materials. Fine grasses, mosses, and plant fibers are plastered together with mud, and the nest is lined with hair or wool. The eggs number four to six. They are generally snow white. Occasionally, one or two may be thinly spotted with brown.

Few birds are more helpful in destroying insects. The phoebe dashes tirelessly about in its aerial search for food. It rests on a limb of a tree or on a wire of a fence, watching alertly for insects. While it waits it jerks its tail nervously and utters a whistled "Phoe-be." Suddenly it sallies forth and seizes its prey; then it circles back to its perch. It devours many harmful insects including May beetles, click beetles, and boll weevils. The phoebe is also a great check on gnats, flies, and mosquitoes.

KINGBIRD

PLATE 9

Tyrannus tyrannus

LENGTH: 8 or 9 inches.

RANGE: Breeds in North America from the British provinces south through the United States except southwestern portion; winters in Mexico and south to northern South America.

Although the kingbird shows preference for streams and shallow lakes, it is generally a bird of field and orchard. It is the warrior of its region. Not only does it fend for itself but it protects other birds of its vicinity. It relentlessly pursues crows and hawks that prey on weaker birds. Snapping at the back of a marauding bird, the kingbird forces the thief to continue its flight. It will cease only when it has driven the foe from its field. It gained its name "kingbird" from its fearless attack on crow or hawk.

The rather bulky nest of woven grasses, fibers, and wool is usually found on a horizontal branch of an apple tree. The eggs, three to five in the one brood each year, are a creamy white splashed with chocolate brown.

Like all of the flycatchers, the kingbird seeks most of its food on wing. Sitting on a high branch of a tree or on a barbed-wire fence, it remains almost motionless. Suddenly it darts out and seizes an insect. Then it circles back to its perch to repeat the performance many times. After a storm, when insects are few in the air, the kingbird feeds upon the ground. It gathers the insects that could not withstand the wind and rain. The kingbird is unjustly called "bee martin." It is accused of devouring honeybees, but investigation has proved that bees form a small part of its diet. Those which it eats are largely drones, the useless bees of the hive. Moreover, it devours robber flies which are destructive to honeybees. Seeds and wild fruit compose the vegetable matter. Seven-eighths of the food consists of harmful insects; these include blister beetles, rose chafers, grasshoppers, moths, butterflies, and caterpillars.

ARKANSAS KINGBIRD

PLATE 9

Tyrannus verticalis

LENGTH: About 9 inches.

RANGE: Breeds in southern Canada and the United States from the Pacific coast to Manitoba and the Mississippi Valley; winters in Mexico.

Regions of scattered oak in the hill country are favored haunts of the Arkansas kingbird. Though fearless of other birds, it shuns the society of man. Rarely does it venture near dwellings. Occasionally it places its crudely constructed nest in a bush or low oak on the outskirts of a ranch or an orchard. This flycatcher has a somewhat quarrelsome nature. It disputes the right of any bird that ventures within its territory. Large is its dominion, for it is "monarch of all it surveys."

Like all of the other flycatchers, the Arkansas kingbird secures its food while in flight. Darting nervously about in the air, it captures myriads of insects. It is accused of being harmful in its destruction of honeybees, but most of the bees devoured are the idlers of the swarm. Wild berries and a few seeds comprise about one-eighth of its food. The balance is composed of insects of largely harmful species, such as wasps, grasshoppers, crickets, and beetles. The white edge of the feather on each side of the tail distinguishes the Arkansas kingbird from all other flycatchers except the gray and salmon-colored scissortail of Texas.



Nest and eggs of the bluebird

BLUEBIRD

PLATE 10

*Sialia sialis sialis*LENGTH: About $6\frac{1}{2}$ inches.

RANGE: Breeds in North America east of the Rockies from Manitoba and Nova Scotia to the Gulf of Mexico; winters from the Middle states south to Mexico, Guatemala, and the West Indies.

When snow still lingers on the ground, the soft, sweet warble of the bluebird proclaims that spring is on the way. The early arrival of this beautiful gentle bird has endeared it to all nature lovers. It was once one of the familiar dooryard birds, but meddlesome sparrows, squirrels, and cats have driven it away. Now it generally inhabits distant orchards or the borders of woodland.

Only a few venturesome bluebirds nest near dwellings or in village gardens. The nest is placed in the cavity of a tree or post, or in a well-protected bird house. It is composed of wisps of hay or straws and is lined with feathers and bits of other soft material. Four to six pale blue eggs are laid. Two and sometimes three broods are raised. The tireless parents are kept busy feeding insects to hungry nestlings.

About three-fourths of the food of bluebirds is composed of grasshoppers, beetles, and caterpillars. These are all harmful insects except a few beetles that feed on other insects. The remainder of the food consists of small fruit and berries, almost all of which are of wild varieties. The bluebird does no essential harm and on the whole is of benefit to man. It deserves encouragement and protection.

ENGLISH SPARROW

PLATE 10

*Passer domesticus*LENGTH: About $6\frac{1}{4}$ inches.

RANGE: Resident throughout the United States and southern Canada.

The English sparrow was brought to Brooklyn, New York, in 1850, to combat the inchworm pest. Since then it has become naturalized within the greater part of North America. Hardy and vigorous, it can withstand the rigors of severest winters. This noisy, meddlesome gamin is an enemy of our native birds. It often molests them while they are feeding. It drives them away and takes the food for itself. Sometimes it dispossesses them of their homes. As it remains during the winter and nests early, it takes possession of any available nesting place. When bluebirds, phoebes, and martins return in the spring, they find their houses occupied by sparrows, and they are compelled either to fight for possession or to seek a nesting place elsewhere.

English sparrows are a serious problem because of their filthy habits. They gather in large flocks in eaves and gables of buildings. They soil the walls of these buildings with their droppings. They do much damage by building their nests in rain troughs, which frequently causes an overflow of pipes, or befouls the water of cisterns.

By nature this sparrow is a grain eater. It does much injury to grain crops, both in field and in shock. It destroys weed seeds only in winter, when other foods fail. It eats buds, blossoms, and fruits of cultivated shrubs and trees. Insects are destroyed during nesting season only. These include harmful kinds—worms that infest tobacco, and weevils that threaten the alfalfa industry. Should investigation prove that the English sparrow holds in check insects that are injurious to crops, the balance will be in its favor.



PLATE 9.

Wood Pewee
Kingbird
Phoebe

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Arkansas Kingbird



PLATE 10.

House Wren

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Bluebird
English Sparrows
male—female

HOUSE WREN

PLATE 10

*Troglodytes aëdon aëdon*LENGTH: About $4\frac{3}{4}$ inches.

RANGE: Breeds in southern Canada and throughout the United States except in the Gulf and South Atlantic states; winters in southern United States and Mexico.

The lively little singsong of the house wren arouses a friendly feeling toward this active little creature. So loud and long does it sometimes sing that one wonders that such a bubbling warble can issue from so small a throat. It delights to nest in cut timberlands where it builds its home in hollows of stumps. It also shows preference for nooks and crannies about buildings. It often selects most curious places. An old tin can or a flowerpot, set at an angle to suit the wren, is readily taken. This cordial little bird will welcome a small bird house erected for its use.

Wrens return regularly to their old nesting sites. Before occupying the old home, these neat housekeepers indulge in an old-fashioned housecleaning. Every stick and twig is removed from the nook and dropped on the ground for an airing. When they build the new nest, all the old materials are used. Wrens are devoted parents, when the five or six pinkish-brown eggs have produced as many nestlings to be fed insects and spiders. Wrens have a keen appetite for many pests of the garden. Half of their food consists of grasshoppers and beetles. One-third is composed of caterpillars and bugs. The remaining part is largely spiders. A bird with such helpful habits and spirited song is worthy of cultivation.

FLICKER

PLATE 11

Colaptes auratus luteus

LENGTH: 12 to 13 inches.

RANGE: Breeds in North America south of Hudson Bay and east of the Rockies; winters in southeastern United States.

One of the most handsome of woodpeckers is the flicker. It attracts attention both because of its color and because of its voice. Its most common call is heard most often in springtime. It is an oft-repeated clear, sharp "Fleek-ah, fleek-ah, fleek-ah." Like all woodpeckers, the flicker nests in cavities of trees or posts. It often uses deserted holes of other woodpeckers. Friendly and fearless,

it responds to encouragement. It readily appropriates a long bird box nailed to a tree. The flicker delights in splashing about in water. A drinking vessel, large enough for bathing, attracts it toward the house.

Woodpeckers as a family secure food by pecking into decayed wood for insects. The flicker gets much of its food on the ground. Of all foods that nature has supplied wild birds, the flickers like nothing better than ants. With its long bill it tears up an ant hill. The disturbed little creatures rush out to discover the cause of the commotion. The flicker thrusts out its long tongue and seizes many at once. Ants compose more than half of the flicker's diet. Ground beetles and bugs complete the animal substance. The vegetable food of the flicker is composed mainly of wild fruits, such as chokecherries, black cherries, sour gum, and candleberries.

YELLOW-BELLIED SAPSUCKER

PLATE 11

Sphyrapicus varius varius

LENGTH: About $8\frac{1}{2}$ inches.

RANGE: Breeds in southern Canada and the northern half of the United States; winters in most of the United States and south to the West Indies and Costa Rica.

The yellow-bellied sapsucker is better judged by its works than by its appearance. Its habit of piercing the bark of trees to secure the flowing sap has given it the name of sapsucker. Apple, birch, hard maple, and red oak are most frequently pecked and girdled. The squarish holes puncture the inner bark. This is the cambium layer, the living tissue of the tree. Occasionally, saplings are killed outright. Forest trees, attacked in successive years, generally die in the third year. But greater loss is caused by stains and blemishes in the lumber. Defects due to sapsucker work cause a yearly loss to the lumber industry estimated at \$1,250,000.

While busily engaged at sapsucking, this woodpecker remains very quiet. Whenever a sound is uttered, it is a feeble call note that scarcely attracts attention. At the approach of an intruder the sapsucker seeks the far side of the tree. As if conscious of misconduct, it keeps a tree between itself and the observer. Sapsuckers are noisy fellows when they frolic in trees together. They chase one another about, screaming in loud discordant voices.

The sapsucker's nesting habits are also destructive. A dead birch

sometimes serves, but limbs of living trees are generally hollowed to a depth of eighteen inches. It is true that the sapsucker eats insects attracted to the sappy bark. The destruction of ants, in this fashion, counts in the bird's favor. Of all the woodpeckers, however, it least deserves protection.

DOWNY WOODPECKER

PLATE 11

Dryobates pubescens medianus

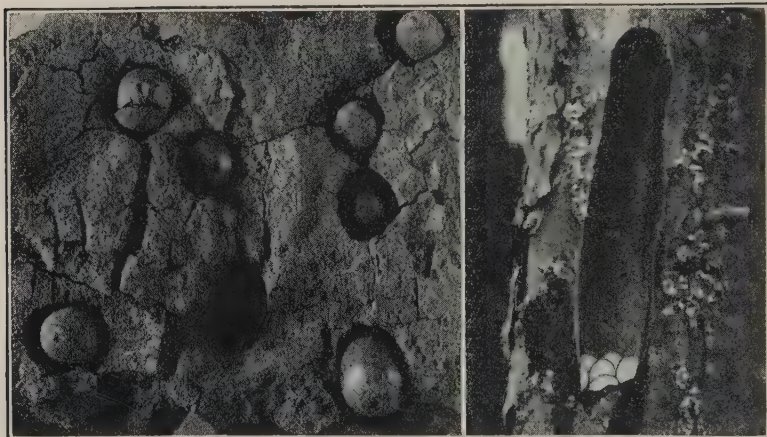
LENGTH: About 6 inches.

RANGE: Resident in the United States and the wooded regions of Canada and Alaska.

No larger than an English sparrow, the downy woodpecker is the most active and useful of its tribe. It keeps up a tireless search for insect pests throughout the year. Only bitter wintry blasts will send it back to its comfortable retreat. Downy is a familiar resident of woodlands, orchards, and roadsides. Early in the spring it seeks a new building site. Though old quarters may be used for winter shelter, they are never again occupied as a home. Each spring finds this little carpenter chiseling a hole in a dead branch of a tree. On a bed of chips in the bottom of the cavity, four to six white eggs are laid.

Much of the food of this little woodpecker is secured from dead or decaying wood. Many larvae and pupae of insects are devoured. But the downy is also a searcher of insects that infest the branches and twigs of healthy trees. It alights near the base of a tree and with short, jerky bounds it climbs straight upward. Frequently it pauses to tap the bark with its bill to test whether the wood is solid. If a responding sound indicates the presence of an insect, its sharp bill makes the chips fly. No larvae can then escape the keen eyes or spearlike tongue of this forester. Often while hammering it pauses to utter a sharp "Peek, peek." If it is content with the food secured, it gives a rattling cry, which ends as abruptly as it began.

Downy is mainly insectivorous. It devours many caterpillars, beetles, locusts, and grasshoppers. It is credited with destruction of eggs of moths and beetles. This prevents broods of larvae from hatching that are harmful to vegetation. It never eats fruits of orchard trees. When in need of vegetable diet it feeds on the seeds of poison ivy, pokeberry, woodbine, and dogwood. The only fault of this friendly worker is the distribution of poison ivy seeds.



One of the woodpecker's methods of storing food for winter is to place acorns in holes in trees, as shown on the left. On the right are the nest and eggs of the downy woodpecker

RED-HEADED WOODPECKER

PLATE 11

Melanerpes erythrocephalus

LENGTH: $9\frac{1}{4}$ to $9\frac{3}{4}$ inches.

RANGE: Generally resident from southern Canada to the Gulf states and from the Hudson and Delaware rivers to the Salt Lake Valley and Arizona.

The noisy redhead is the common woodpecker of country roadsides. Its striking plumage rarely escapes notice as it rests on a favorite fence post. Darting from post to telegraph pole, it attracts attention by screeching a harsh rattling cry. A dead limb or trunk of a tree or a high post is a favorite nesting place. Both parents take turns at chiseling a deep pocket for the four or six glossy white eggs. As soon as the nestlings are strong enough they climb to the opening of the hollow. There they cling with their gray heads hanging out, clamoring lustily for food.

The red-headed woodpecker has peculiar feeding habits. Like a shrike, it scans field or meadow from a perch. When it sights a grasshopper or a large beetle, it darts down to seize the prey. As it flies back, it catches an insect much as a flycatcher captures its food. The red-headed woodpecker stores nuts and other edibles in curious places. Crannies in walls, holes in posts, or hollows in trees

often become its storehouses. Unfortunately, this bird of attractive plumage is an example of the saying: "Fine feathers do not make fine birds." It possesses the disagreeable trait of eating the eggs and young of other birds. More than half of its food is vegetable substance. It eats corn in the milk. It devours fruits, including many cultivated varieties. The animal food consists largely of insects, which include many helpful ground beetles. Perhaps the most good that the red-headed woodpecker does lies in destruction of caterpillars, grasshoppers, corn weevils, and plant lice.

INDIGO BUNTING

PLATE 12

Passerina cyanea

LENGTH: $5\frac{1}{2}$ inches.

RANGE: Breeds from southern New Brunswick and Ontario south through the United States to Georgia, Louisiana, and Texas; winters from southern Mexico through Central America.

This gleeful little songster is as cheerful and bright as the radiant blue coat that he wears. He cares not for wind or for weather. In rain or in shine, throughout the summer, he merrily sings. The hotter the weather, the more jubilant is he. His song is often confused with the warble of the goldfinch, but it is more sprightly and joyous.



Nest and eggs of the indigo bunting

What a surprise the bird student receives when he discovers that the indigo's mate is a plain drab-colored sparrow! She is a shy and retiring mother. She builds a nest of grasses and fibrous materials, including, usually, many dried leaves which conceal the nest and the nestlings. In order to make concealment still better, she places the nest in a thicket of hazel or in dense underbrush. Two broods are commonly reared. Each clutch numbers three or four eggs of a dainty blue-white color. After the nesting season is over, indigo birds are shy and timid; they seek the denser foliage of woodlands.

By preference, the indigo is a vegetarian. Its food consists largely of weed seeds and a small quantity of berries. It does not, however, shun insects. It is most helpful to farmer and orchardist in destruction of cankerworms, click beetles, snout beetles, caterpillars, and chafers.

WHITE-CROWNED SPARROW

PLATE 12

Zonotrichia leucophrys leucophrys

LENGTH: 7 inches.

RANGE: Breeds in Canada and in the mountains of the northwestern United States; winters from the southern half of the United States to the valley of Mexico.

White-crowned sparrows are sociable travelers. They mingle with other sparrows during migration. It is then that the white-crowned sparrow is confused with its equally handsome cousin, the white-throated sparrow. The former is a trifle larger. It lacks the yellow spot before the eye, which is a distinct mark of its relative. The white-crowned sparrow is more numerous in high mountainous regions. It nests in wooded ravines or on hillsides. The nest is placed on the ground under brush, or occasionally in a low bush. It is large and loosely constructed of grasses, twigs, and leaves. The eggs number four or five. They are pale blue or light tan, thickly spotted with reddish-brown.

The white-crowned sparrow gets much of its food on the ground. Like the towhee, it scratches for insects and seeds. It is a persistent eater of weed seeds. Insects form a small portion of its diet. Beetles, caterpillars, ants, wasps, and bugs are freely destroyed during nesting season. Though the white-crowned sparrow is accused of eating buds and blossoms of fruit trees, it does little damage.



PLATE 11.

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(Flying) Red-headed Woodpecker (young)

Red-headed Woodpecker

Downy Woodpecker

Yellow-bellied Sapsucker

Flicker



PLATE 12.

American Goldfinch
Chipping Sparrow

Towhee

© Painted expressly for THE CLASSROOM TEACHER

Indigo Bunting
White-crowned Sparrow
Song Sparrow

CHIPPING SPARROW

PLATE 12

*Spizella passerina passerina*LENGTH: About $5\frac{1}{4}$ inches.

RANGE: Breeds in southern Canada and in the United States south to northern Mexico; winters from the Gulf states south to Nicaragua.

The chipping sparrow is one of the most modest of its tribe. Were it not for its constant low chipping, this plain inconspicuous bird would rarely be noticed. It is very tame and confiding. So amiable does it become that it often builds its nest near dwellings. Frequently it selects a tangle of vines that grow on the side of a house; more often a bush or tree is chosen. The cup-shaped nest is composed of grasses and rootlets, always thickly lined with hair. The chipping sparrow is often called "hair sparrow." It is one of the few birds that continue to sing during the summer. Though its song is monotonous, the tremulous trill is pleasant to hear when other bird music has ceased.

The chippy is the most insectivorous sparrow. It is most destructive to the injurious pea louse, a dreaded pest of the farmer. It is an enemy of the gypsy moth, beet worm, and currant worm. It destroys many beetles, ants, wasps, and spiders. It also devours bugs, including olive scales and plant lice. When feeding its young it gathers numerous spanworms and caterpillars. Its vegetable diet is mostly weed seeds. So valuable a bird is worthy of cultivation.

AMERICAN GOLDFINCH

PLATE 12

*Astragalinus tristis tristis*LENGTH: $4\frac{1}{2}$ to 5 inches.

RANGE: Breeds in southern Canada and in the United States south to Georgia and southern California; winters mainly in the United States.

Goldfinches are always sociable. They wander in merry companies. The vivid golden-yellow of the male in summer contrasts sharply with the modest brown-yellow of the female. They are happy little creatures. They voice their contentment constantly while on wing. Their flight is a peculiar wavelike motion, accompanied by a chirping twitter of four syllables. The joyous warbling song resembles the song of a canary.

The goldfinch is the last of the birds in nest building. When early thistles supply abundant plant down for lining the nest, the mother bird begins seeking a nest site. She selects a bush or low tree, most often a willow or alder. In a forked twig she places a deeply hollowed cup. It is made of grasses and lined with silken fluff of the thistle and other downy plant fibers. The three to six eggs are a dainty, pale blue. Occasionally they are spotted with brown. The father bird is kept busy feeding his mate while she broods.

Though the goldfinch is chiefly a seed eater, it varies its diet with insects. It destroys many cankerworms, pests of the orchard. It is actively helpful in checking the Hessian fly of the grainfields. Grasshoppers, plant lice, and beetles are also included in its bill of fare. The goldfinch is often called "lettuce bird" because of its fondness for lettuce seeds. At times it becomes a trial to the lettuce-seed grower. However, it does insufficient harm to warrant destruction of goldfinches. On the other hand, it destroys many seeds of thistle, wild lettuce, and dandelion. These plants are a nuisance in a field of lettuce.

SONG SPARROW

PLATE 12

Melospiza melodia melodia

LENGTH: About $6\frac{1}{4}$ inches.

RANGE: Breeds in southern Canada, southern Alaska, and in the United States south to Missouri and Virginia; winters in the United States from Massachusetts and Ohio southward.

This little messenger of spring goes North when snow still hides the earth and winter winds are strong. The song sparrow can easily be distinguished from the other dull-colored birds of its tribe. It has a speckled breast with a heavier spot on the chest. What it lacks in appearance, it makes up in its song of cheer. Before early spring snows melt and buds begin to awaken, it sits in hedges or in little trees, where it trills its merry song. Song sparrows vary greatly in color, song, and habits. They are at home in swamp, field, roadside, or garden. Any place, if water is near, may become the haunt of the song sparrow.

The nest is often placed on the ground. Frequently it is hidden in brush or in a hedge. It may be deep and bulky or shallow and flimsy. Usually it is made of coarse grasses, leaves, and bits of bark.



Nest and eggs of the song sparrow (left) and of the towhee (right)

It is lined with fine grasses. Three to six eggs are laid, light green or blue in color, and always spotted with dark brown. Insects comprise about one-fourth of the food. These include weevils, spanworms, wasps, black-olive scales, and caterpillars. Seeds of harmful weeds compose the remainder of the diet. Because of its beneficial habits, the song sparrow merits protection.

TOWHEE

PLATE 12

Pipilo erythrophthalmus erythrophthalmus

LENGTH: 8 to 8 $\frac{3}{4}$ inches.

RANGE: Breeds in southern Canada and in the United States south to Georgia and central Kansas, and west to the Rocky Mountains; winters from the Potomac and Ohio valleys and southern Nebraska southward.

A vigorous scattering of dead leaves accompanied by "Che-wink', che-wink'," is a sure sign that the towhee is about. It is a shy and nervous bird. It is most at home on the ground under hedges and brushes. With jerky motion it scratches energetically for insects. It is ever on the alert for intrusion. Only when it sings its tremulous "Tow-hee-ee-ee" does it seek the high branches of bush or tree. The slightest disturbance sends it dashing back into the underbrush.

The large nest is placed on the ground in a brush heap. In rare cases it is built in low bushes. It is roughly constructed of twigs, sticks, leaves, and bark. The lining is made of rootlets and fine grasses. The nest is well concealed. It corresponds in color and in

material to the surroundings. Rarely is it disclosed when the mother bird is brooding. Her cinnamon-colored back resembles the dried leaves about her. The four or five white eggs are evenly spotted with reddish-brown.

Insects and seeds largely compose the food of the towhee. A small amount of wild fruit and berries is eaten. Among the insect food are grubs, caterpillars, grasshoppers, flies, and beetles. The towhee is a great aid in destroying the cotton-boll weevil. Because of its slight resemblance to the robin, it is often called "ground robin."

STARLING

Sturnus vulgaris

LENGTH: About $8\frac{1}{2}$ inches.

RANGE: Breeds from central Maine to South Carolina and west to the eastern part of the Mississippi Valley.

Children throughout the district between the Allegheny Mountains and the Rockies should be on the lookout for this active little visitor, which has gradually spread westward from New York, where it was introduced from Europe in 1890. The starling is a winter resident bird. Its black glossy coat has an iridescent gleam; the upper feathers are touched with a creamy-buff color which is lighter in winter. It utters a loud, clear whistle which is sometimes mingled with a medley of other tones. When it is alarmed, it sounds a coarse, rasping note. It is somewhat of a mimic, too, and can repeat the notes of a number of our native birds. The bird most frequently imitated is the wood pewee, whose plaintive "Pee-a-wee" is reproduced with such delicate skill that it cannot be distinguished from the song of the woodland flycatcher itself.

The starling is a quarrelsome little creature; it attacks nearly all species of hole-nesting birds. Upon driving the lawful owner out, the starling appropriates the nest for its own use. It builds its nest in hollow trees, old woodpecker holes, and in eaves and crannies about buildings. Sometimes it chooses curious places, such as fire escapes, barn doors, or the backs of window shutters. The nest is made of dry grasses, shot here and there with light-green foliage and is lined sparingly with feathers of domestic fowl. The eggs are of a pale greenish-blue color and number from three to six; there are two broods a year.

Starlings mingle in great flocks, sometimes as many as a thousand



Courtesy, Bureau of Biological Survey

The starling has a black, iridescent coat, the upper feathers of which are touched with light buff. This roost, showing hundreds of birds, was photographed in a residential section of Washington, D.C.

during the day. Roosts are frequently in trees in residential sections of cities. Occasionally, a roost will be formed in a cat-tail marsh or in other open places. These open roosts are abandoned in October or November, however, for shelter in church towers and barns. There the birds gather nightly until spring, when the flocks are broken up by the mating instinct. The starling's food consists principally of insects, including millipedes, spiders, many kinds of beetles, and caterpillars. Its diet includes small fruits, such as cherries, strawberries, and grapes; also a small amount of apples, pears, and peaches. It eats corn in the milk, pulls up sprouting corn, and eats tomatoes. However, the insect food of the starling will place it in the ranks of birds beneficial to the farmer.

CROW BLACKBIRD (BRONZED GRACKLE)

PLATE 13

Quiscalus quiscula aeneus

LENGTH: About 12 inches.

RANGE: Breeds in the eastern United States and southern Canada west to the Rockies; winters in the southern half of the eastern United States.

Early in the spring, before vegetation has begun to leaf out, large flocks of crow blackbirds alight in trees or walk leisurely upon the ground. They are always found in companies, even during the breeding season. They are at home in country, town, or city, and frequent open fields and lawns. This grackle can lay no claim to musical ability. Its vocal performance cannot be called a song; it is a repetition of sharp metallic squeaks which have been likened to the creaking of a rusty hinge. Often a whole flock will perch in a tree and pour forth a chorus of loud, discordant sound.

Thick tops and dense branches of evergreens are favorite nesting places. Frequently, neighboring trees hold a dozen or more of the bulky nests. Twigs, grasses, feathers, and weeds are held together with mud and lined with fine grasses. The four to six eggs vary in color from a soiled blue to a dirty white, clouded and speckled with brown. Generally, crow blackbirds are not popular with farmers, as they do much damage to grainfields. In the early spring they pull up sprouted grain. Later in the season, when young and old forage for food, large flocks descend upon grainfields. Nevertheless, the work that the bronzed grackle does in destroying insects is valuable. Beetles, caterpillars, and grasshoppers are an important part of the food. The grackle does invaluable good by eating larvae of May beetles. These "white grubs" are an enemy of grass and grainlands. In general, the crow blackbird is a helpful species. It is only when they are numerous that grackles are harmful to crops.

BALTIMORE ORIOLE

PLATE 13

Icterus galbula

LENGTH: 7 to 8 inches.

RANGE: Breeds from southern Canada to the Gulf states, east of the Rockies; winters from Mexico to Colombia.

A shrill, clear whistle that seems to say "Lu-k, lu-k, luk-a-here," announces the arrival of the Baltimore oriole. He returns when

fruit trees begin to blossom. Gayly he searches the terminal sprays and probes the flowers for insects. From twig to twig he darts, like a brilliant flash of fire. A few days later his less brilliant mate



The beautifully woven nest of the Baltimore oriole. (The lower opening was cut to show the eggs at the bottom of the nest)

arrives. She travels northward leisurely, in company with other females. An unexcelled weaver is the mother bird. Firmly, but lightly, she suspends a long pouch from the end of a swaying branch of a tree. Most often she chooses an elm, a willow, or a soft maple. The nest is exquisitely woven of grasses, bits of string, and other soft, long-fibered material. Gay-colored threads of yarn strewn about on the lawn or in bushes sometimes induce this weaver to build in a tree near the house.

The Baltimore oriole is as useful as it is attractive. It is an active enemy of the injurious cotton-boll weevil. It feeds freely on apple-tree tent caterpillars, leaf beetles, plant lice, and scale insects. It also eagerly devours ants, grasshoppers, locusts, and spiders. It is destructive to small quantities of fruit, but this injury is very slight compared with the invaluable service this oriole renders in consuming countless harmful insects.

BOBOLINK

PLATE 13

Dolichonyx oryzivorus

LENGTH: 7 to 7½ inches

RANGE. Breeds from the Middle states north to Manitoba and Nova Scotia; winters in South America.

When late in spring there floats from field or meadow a gurgling, songlike, rippling laugh, then bobolink has returned. From the time that bobolinks arrive until the nestlings can care for themselves, the male sings constantly. He is the minstrel of the meadow. Soon after their arrival, bobolinks begin to build their nests. The nest is a simple structure of grass, placed in a shallow depression on

the ground, amid a dense growth of grasses and reeds. It is so well concealed that it is difficult to discover. The female never leaves or returns to her nest directly. She goes through a channel in the grass. The male does not sing near the nesting site.

During nesting season, the bobolink is a desirable bird. Not only is it a delight to eye and ear, but it is most useful in destroying insects. Grasshoppers, cutworms, army worms, caterpillars, and weevils are included in the diet. When the fledglings leave the nest, the father bird molts. Then he and the young resemble the dull, sparrow-like mother. It is then that they are known as reedbirds. In flocks, they roam over grainfields and meadows, feeding upon grass and weed seeds, and occasionally on grain.

It is in the Southeastern states, where bobolinks are called rice-birds, that they have gained ill repute. Formerly, when large areas were devoted to rice culture, these birds wrought much damage. During migration in the spring they uprooted young plants; on their return in the fall, large flocks made great inroads on rice in the milk. Since the acreage has been reduced in the rice-raising districts, bobolinks are winning approval.

MEADOW LARK

PLATE 13

Eastern, *Sturnella magna magna*; western, *Sturnella neglecta*

LENGTH: About $10\frac{3}{4}$ inches.

RANGE: Breeds in southern Canada, the United States, and south to Costa Rica; winters from the Potomac and Ohio valleys and British Columbia southward.

The meadow lark is a bird of the open country. It prefers fields and meadows where oozy pools lie or where streamlets flow. Like most members of the blackbird family, it likes to mingle with other birds. It is often found with redwings and bobolinks. The song of the meadow lark varies in length and quality according to the season. It is always joyous. In the early spring it is composed of four syllables, "Sol, sol', mi, la'." It is a high whistle. Some people say that the meadow lark sings "The spring is here!" Happy is the farmer when he hears this strain, for it tells him that the spell of winter is broken. Eastern and western meadow larks are similar in appearance and habits. The song of the western lark is louder, clearer, and more melodious.

The meadow lark conceals its nest in the grass on the ground.



Nest and eggs of the bobolink (left) and of the meadow lark (right)

It is made of grass with a dome of woven grasses. The food consists almost wholly of insects and seeds of grasses and weeds. The amount of grain it eats is almost too small to be considered. The meadow lark is an active enemy of the boll weevil, the pest of all cotton-growers, and it is very fond of alfalfa weevils. It also devours many grasshoppers, cutworms, army worms, and spiders. No bird can make stronger claim for protection.

COWBIRD

PLATE 13

Molothrus ater ater

LENGTH: About 8 inches.

RANGE: Breeds in North America from southern British Columbia and New Brunswick south to the Gulf states; winters in the southern United States and Central America.

The cowbird takes its name from its close association with cattle in the pasture. It follows them about, waiting for insects which they disturb in grazing. Sometimes it perches upon the back of a cow and is carried to another feeding place. The female is an unnatural mother. She never builds a nest or takes care of her young. She lays her egg in the nest of smaller birds, such as warblers, vireos, and chipping sparrows. Usually the egg is hatched together with the rightful eggs of the nest. The young cowbird is often reared at the expense of the other nestlings. It is much larger

and stronger and so demands the greater part of the food brought by the parents. It is quite common to see a pair of yellow warblers feeding a young cowbird on the ground. He may be the sole survivor of their brood.

The insects that the cowbird eats are largely harmful. It avoids beetles that feed on other insects; these are beneficial to man. Its vegetable food consists of weed seeds and a small portion of grain. In food habits the cowbird is not harmful, but it must be remembered that in causing the death of many valuable nestlings this bird does much injury.

RUSSET-BACKED THRUSH

PLATE 14

Hylocichla ustulata

LENGTH: About $7\frac{1}{4}$ inches.

RANGE: Breeds in forested regions of Alaska and Canada and south to California and Colorado; winters from Mexico to South America.

The russet-backed thrush travels northward in small flocks, often in company with white-crowned sparrows. It loiters along the way in shrubby roadsides, parks, and gardens, never straying far from a stream or from running water. Frequently during migration its song is heard. At this time the song is metallic and ends in a rolling, plaintive strain. Not until the russet-backed thrush reaches its breeding grounds does it burst into melodious song. Then its musical lay is liquid, and includes strains like the tinkling of a silver bell. It belongs to the small group of thrushes which many persons rank first among American song birds.

Low bushes or evergreens are this thrush's favorite nesting sites. Twigs, strips of bark, leaves, and moss are used to construct the nest. The lining is composed of rootlets. Three or four greenish-blue eggs, spotted with reddish-brown, compose the clutch. The largest portion of the animal food is secured from the ground. Turning leaves over, the russet-backed thrush secures many snails and slugs. Probing into decayed vegetation, it picks up various insects. It destroys beetles, ants, and caterpillars. It does considerable damage to fruits of orchard and garden, and is especially troublesome during cherry season, when the young are in the nest. Nevertheless, it is of sufficient service as an insect destroyer to warrant its protection.



PLATE 13.

Baltimore Oriole
Bobolink (male)
Bobolink (female)

© Painted expressly for THE CLASSROOM TEACHER
Bronzed Grackle
Cowbird
Meadow Lark (Eastern)



PLATE 11.

Black-headed Grosbeak
Russet-backed Thrush

© Painted expressly for THE CLASSROOM TEACHER
Bullock's Oriole
California Jay

BLACK-HEADED GROSBEAK

PLATE 14

Zamelodia melanocephala

LENGTH: 8 to 8½ inches.

RANGE: Breeds from the Mississippi River west to the Pacific coast and from southern Canada to the plateau of Mexico; winters in Mexico.

This rollicking songster is a frequenter of garden and orchard. Its gladsome song resembles that of the tanager and robin. It sings with greater spirit in the early morning. It is one of few birds that sing at home. The gayly-colored male carols joyously on a branch near the nest, while often his sparrow-like mate croons a lullaby to her nestlings. The nest, a loose structure of twigs, is lined with fine plant fiber and rootlets. In its northern range the nest is placed in maple, dogwood, or alder. Chaparral and willows are favorite sites in the South. The eggs, three or four in number, are pale blue, densely freckled with brown.

The black-headed grosbeak is accused of destroying much fruit. Figs, apricots, cherries, and berries are its favorites. However, these constitute less than one-fourth of its diet. It destroys many insects injurious to fruit crops. Codling moths, cankerworms, and flower beetles are greedily devoured. It is an active foe of the black-olive scale. In actual measure, the black-olive scales destroyed total more than one and one-half times the amount of fruit eaten by this grosbeak. The destruction of this pest alone more than repays fruit-growers for the fruit which the black-headed grosbeak consumes.

BULLOCK'S ORIOLE

PLATE 14

Icterus bullocki

LENGTH: About 8 inches.

RANGE: Breeds from the Pacific coast to the Mississippi Valley and from southern Canada to northern Mexico; winters in Mexico.

This bird of vivid plumage is the hang-nest bird of the West. Gardens and orchards are its favorite foraging grounds. There it gleans most of its food from the trees. Rarely does it feed on the ground. Frequently it chooses a tree near a dwelling in which to place a pouch-like nest. The pocket is durably woven of slender

grasses, plant fibers, and hair. It is usually fastened by the upper border to drooping twigs of a swaying branch. The pouch varies in size and in shape. In unsettled and open regions, hawks are dreaded enemies of the oriole. To protect themselves against these marauders, orioles weave their nests from ten to twelve inches long and partly close them at the neck to hide the mother and the nestlings. When the fledglings leave the nest, old and young disappear from garden and orchard. Together they forage for their food in the leafy crowns of the higher trees in woodlands and in swamps.

Bullock's oriole is chiefly insectivorous. Nearly half of its diet is composed of grasshoppers, moths, and caterpillars. Beetles, devoured in large numbers, form about one-third of its food. Olive scale, plant lice, ants, and wasps are also included in its fare. Less than one-tenth of the food is vegetable matter, composed mainly of small fruits. Its fondness for cherries makes it an unwelcome guest in cherry orchards.

CALIFORNIA JAY

PLATE 14

Aphelocoma californica

LENGTH: About 12 inches.

RANGE: Resident in California and north to Washington and south to southern Lower California.

Though the California jay possesses most of the offensive traits of its blue relative, it is less suspicious. It becomes so gentle and tame upon close acquaintance that it will eat nuts and insects from the hand of man. It is then one can scarcely believe that this bird of beautiful plumage is a bold, impudent rascal. It is sly, noisy, quarrelsome, and meddlesome. It is even a greater villain than the blue jay at robbing the nests of other birds. Sometimes it destroys eggs and nestlings for mere pleasure. It is as skilled as the crow in stealing chickens; many young chicks become its prey. The nesting habits of the California jay are like those of its relative, the blue jay (see p. 151).

The common call of the California jay is a hard jerky scream, "Bee-bee, bee-bee." From this it has acquired the name "bee-bee bird" in some localities. It delights in misleading and frightening other birds by giving hawklike cries. The vegetable diet consists largely of mast. Under some circumstances the California jay be-

comes a nuisance in its injury to cultivated fruit and grain. One-tenth of the animal food consists of harmful insects, grasshoppers, moths, and caterpillars. The remainder includes the eggs and young of many beneficial birds. Where this jay is abundant, it is a detriment to field and orchard.

SCARLET TANAGER

PLATE 15

*Piranga erythromelas*LENGTH: 7 to $7\frac{1}{2}$ inches.

RANGE: Breeds in southern Canada from Manitoba and Ontario south through eastern United States, west to the Plains, and south to Arkansas, South Carolina, and Georgia; winters in the West Indies and in Mexico, and south to northern South America.

Scarlet tanagers once frequented open country, orchards, and gardens. The brilliant plumage of the male made him an easy mark for sportsmen, and his gorgeous feathers were used for ornamentation. This persecution of tanagers caused them to become suspicious and cautious. Now they are usually found in woodland and forest. They favor groves of swamp maple and oak that border marshes and rivers. The song of the male is much like the song of a robin, but it is less varied and less sweet.

Perched high in a tree, the tanager sings, but the hearer often fails to locate him. Keen eyes are needed to detect this brilliant songster in the leafy crown of a tree. What rapturous joy is experienced when a gleam of his scarlet coat is revealed! The dull yellow-green of the female serves as an excellent protection. As she sits on her nest amid the green foliage, she rarely attracts attention. She usually lays four greenish-blue eggs, spotted with purple and brown. The nest is loosely constructed of twigs, rootlets, and fibrous material. It is commonly placed on an extended branch of a forest tree.

As soon as the fledglings can forage, the father bird molts. He sheds his gay plumage for the olive-green of his mate without changing the black of his wings and tail. This is his dress while he travels in the tropics during the winter. Before journeying northward, he again dons his suit of scarlet and black. Scarlet tanagers destroy numerous insects, many of which are captured on the wing. They are especially destructive to gypsy moths, leaf-rolling caterpillars,

gall insects, potato beetles, click beetles, and weevils. They also devour great quantities of seed. Small fruits, such as blueberries and elderberries, form a small part of their food.

ROSE-BREASTED GROSBEEK

PLATE 15

Zamelodia ludoviciana

LENGTH: About 8 inches.

RANGE: Breeds from the Carolinas, Ohio, and Kansas north to southern Canada; winters from Mexico to northern South America.

When trees in orchard and forest have begun to blossom, this lovely songster returns. The flashing beauty of the male attracts attention. His dull-colored mate is so unlike him that she is often mistaken for a large sparrow. The delightful song of the male is not unlike that of robin or oriole; it is clear, sweet, and mellow. Sometimes on a clear, moonlight night he bursts forth into melodious song. He is one of a few birds that sing at night. He is a devoted father, helping to hatch the eggs and rear the young. The bulky nest of slender twigs, fiber, and vine tendrils is placed insecurely in the fork of a tree. Frequently, second-growth oaks are chosen for nesting sites.

The food of the grosbeak is varied. When it first arrives from the South it eats buds and flowers of fruit trees. Later it feeds on peas and fruits. The little damage that is done is far offset by the grosbeak's attack on harmful insects. It destroys Rocky Mountain locusts, cucumber beetles, scale insects, wood borers, and potato bugs. Indeed, because of its fondness for the Colorado beetle, it is called "potato bug bird." No bird deserves greater welcome or better protection.

RED-EYED VIREO

PLATE 15

Vireosylva olivacea

LENGTH: About 6 inches.

RANGE: Breeds in southern Canada and in the United States south to Washington, Montana, Colorado, Texas, and Florida; winters in South America.

The red-eyed vireo spends its time among the dense leaves of woodland trees and in the shrubbery of lawns. There all of its



At the left are shown the nest and eggs of the rose-breasted grosbeak. At the right are those of the scarlet tanager (above) and of the red-eyed vireo (below)

feeding, resting, and nest-building are done. Well protected by foliage, with which its green plumage agrees, the red-eyed vireo is better known by its voice than by its appearance. It is an untiring vocalist; it sings incessantly during the heat of long summer days when other songsters are silent. The red-eyed vireo has been called the "preacher," because of its manner of singing. Its notes are distinctly characteristic. The song is an up-and-down warble, composed of four phrases. At the end of each phrase the bird pauses as if waiting for its hearers to grasp the message. Each message seems a question; each pause, a short wait for a reply.

The vireo is also known as "little hangnest." Its cup-shaped nest swings from a forked branch of an elm or a maple. Strips of bark, bits of wood, paper, and plant down are firmly and smoothly woven together. Spider webs and the silken gossamer of spider egg cases adorn the outside wall of the nest. Three or four eggs are laid in the lining of bark and vine tendrils. They are white, highly marked with black and brown. The red-eyed vireo, like the little yellow warbler, is often the victim of the indolent cowbird.

The vireo hatches the cowbird's egg with her own. She feeds the young intruder, which generally pushes her own nestlings from the nest.

Insects from foliage of trees and shrubs constitute a large portion of the vireo's food. It probably consumes more spanworms and leaf rollers than any other bird. It has helped remarkably against invasions of the Rocky Mountain locust by eating the young hoppers. Spice bush, sassafras, and other wild berries contribute the vegetable diet. The red-eyed vireo may be regarded as a bird with no objectionable habits.

MYRTLE WARBLER

PLATE 15

Dendroica coronata

LENGTH: About $5\frac{1}{2}$ inches.

RANGE: Breeds from the Hudson Bay region, central Keewatin, and Alaska south to northern British Columbia, Alberta, Michigan, New Hampshire, and Maine; winters from Kansas, the Ohio Valley, and New Jersey south to the Greater Antilles, Mexico, and Panama; on the Pacific coast from central Oregon to southern California.

Myrtle warblers are the first of their tribe to return North in the spring. Unlike most of their relatives, they travel in large companies. They do not frequent dense woodlands but forage in fields and scrubby growths; there grows their favorite food, bayberry or myrtle waxberry. The song of the myrtle warbler is not unusual. Its cheery trill suggests the song of the junco. It is a pleasant warble, "Pheo, pheo, pheo; phew-phee, phew-phee!" The first part is uttered very rapidly, the latter part more slowly.

The nesting site is by choice a damp place among evergreens. Twigs and fine grasses lined with plant fibers form the nest. The grayish-white eggs, splotched with light reddish-brown, run from three to five. Waxberries, poison ivy, and sumac berries make up only one-fourth of this warbler's food. The remaining three-fourths consist of insects. Practically all of these are harmful. Ants, beetles, wasps, plant lice, and plant scales are included in the animal diet. Flies are its largest item of food. Only a few flycatchers and swallows eat as many flies as does the myrtle warbler. Probably its best claim to recognition lies in the fact that it routs insects which escape larger and less nimble birds.



PLATE 15.

Yellow Warbler
Red-eyed Vireo

Rose-breasted Grosbeak

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Myrtle Warbler
Scarlet Tanager



PLATE 16.

Red-tailed Hawk (with Chipmunk)

© Painted expressly for THE CLASSROOM TEACHER
Sparrow Hawk

Cooper's Hawk

YELLOW WARBLER

PLATE 15

Dendroica aestiva aestiva

LENGTH: About 5 inches.

RANGE: Breeds from central Canada and Alaska south to Nevada, New Mexico, Missouri, and South Carolina; winters from Yucatan to northern South America.

The yellow warbler is often miscalled "wild canary." Its sharp slender bill and nervous flitting motion are its distinguishing characteristics. It is no great musician, but it sings early, often, and cheerfully. Its simple, vigorous song "Wee'chee-wee'chee-wee'chee," has a pleasant ring. This active little warbler rarely visits woodland or forest. Its preference is garden, orchard, or bushy brookside. Often in a willow overhanging a stream it places a compact nest, which is fastened to an upright fork at no great distance from the ground. Firmly woven of plant fiber and grasses, the nest is thickly lined with plant down. A complete clutch of eggs numbers four or five. They are bluish-white, marked with brown.

Rarely does the little yellow warbler succeed in laying her clutch, for this mild little bird is a victim of the lazy cowbird. Scarcely is the yellow warbler's nest complete before a cowbird lays her egg in it. The yellow warbler has native wit. Covering the unwelcome newcomer with plant fiber, she proceeds to build another story. The cowbird may repeat her slovenly offense twice, even three times. Each time the warbler builds a new cover. After several stories have been built, the season is late. The yellow warbler then hatches the last laid egg of the cowbird with her own. Like all of its kin, the yellow warbler is chiefly insectivorous. Larvae of cankerworms, black-olive scales, and spiders are consumed in large quantities. Its vegetable diet consists of small fruits.

COOPER'S HAWK

PLATE 16

Accipiter cooperi

LENGTH: Male, about 16 inches; female, 18 to 20 inches.

RANGE: Breeds in southern Canada and the United States; winters from southern United States to southern Mexico.

Cooper's hawk is the much-dreaded chicken hawk of the farmer. It is the boldest thief with which the poultry-raiser has to contend. Suddenly dashing into a poultry yard, it carries away a chick. So

rapidly does it depart that it is almost impossible to kill the thief. Unlike most birds of prey, Cooper's hawk rarely soars aloft on the outlook for food. It flies swiftly and silently from place to place, beating its wings for a few moments, then gliding silently along. Dropping down rapidly at sight of a victim, it seizes the prey; then, swift as an arrow, it speeds away. It makes great inroads on game coverts, destroying many young waterfowl. Quail, partridges, and numerous song birds fall victim to its greed. Throughout the South this bird is familiarly known as "blue darter."

The nest of Cooper's hawk is placed in any kind of tree in which a branch offers a good platform. It is carelessly built of sticks and lined with twigs and bark. It usually holds six pale blue eggs. The female of this hawk is decidedly larger than the male. She is of a duller color, and the feathers of her back are more tinged with brown. Cooper's hawk is often confused with the marsh hawk, a helpful species. It is without the white patch on the rump which characterizes the marsh harrier. Though Cooper's hawk does some good in destroying mice, squirrels, and a few insects, it is decidedly an injurious bird.

SPARROW HAWK

PLATE 16

Falco sparverius sparverius

LENGTH: 9 to 10½ inches.

RANGE: Breeds in Canada, in the United States, and in northern Mexico; winters in the United States and south to northern South America.

This handsome little falcon is a lover of the open country. It is often seen hovering almost motionless above meadow or field. Alert for large insects or field mice, it rests on a dead limb of a tree or on a high post. When it sights a victim from its lookout, it sails into the air. Then it slowly circles about, drops to the ground, and seizes its prey. The sparrow hawk becomes tame when unmolested. Often it watches the farmer as he plows his field. When a grub or mouse is unearthed, the sparrow hawk flies down. Sometimes it alights for an instant under the farmer's horses in an attempt to capture the food.

The sparrow hawk is unlike other birds of prey in nesting. It never builds a home. It chooses a hollow in a tree or a crevice in a crag. Occasionally the abandoned hole of an owl or a woodpecker is

used. During nesting season the father bird soars high in the air. As he circles about in long curves, he repeats the shrill cry of "Kill-ee." In some regions this falcon is known only as "killy hawk." Grasshoppers, crickets, large beetles, and caterpillars form more than half of its food. Mice, shrews, snakes, and lizards are included in the balance. Sometimes this bird "falls from grace" and captures a small insectivorous bird as food for its young. This evil, however, is more than offset by its destruction of insects, mice, and other vermin.

RED-TAILED HAWK

PLATE 16

Buteo borealis borealis

LENGTH: Male, 20 to 22½ inches; female, 23 to 25 inches. (The western red-tailed hawk differs from the red-tail only in its darker color.)

RANGE: Breeds in Canada, Alaska, the United States, and Mexico; winters generally in the United States and south to Guatemala.

Slow of movement and deliberate in action, the red-tailed hawk is one of the most abundant buzzard hawks. It lacks the rapid dash of Cooper's hawk, the great foe of poultry raisers. The red-tailed hawk is especially partial to prairies and sparsely-wooded regions. Its bulky nest of twigs and sticks is placed high in a tree near the edge of a woodland. Two or three eggs of varying color are laid. Some are dirty white and unspotted, others are marked and streaked in great variation. Wheeling high in the air, the red-tail mounts upward and upward until almost lost to view. It sails and circles in wavelike motion. Then suddenly it drops, only to rise again when it has almost reached the earth. While soaring, it repeatedly screams a shrill "Kee-aah." Sometimes it sits leisurely on a prominent limb or a pole in the open, quietly scanning the country for prey.

The food of the red-tailed hawk consists largely of rats, field mice, meadow mice, ground squirrels, and gophers. Occasionally it devours frogs, fish, and snakes. Where rattlesnakes are numerous, it is an active enemy of these reptiles. Insects, centipedes, and crayfish are also included in its diet. Unfortunately it sometimes attacks poultry and song birds. Nevertheless, it is a beneficial bird because of its check on rodents.



Nest and eggs of the great blue heron

GREAT BLUE HERON

PLATE 17

Ardea herodias herodias

LENGTH: 42 to 50 inches.

RANGE: Breeds from northern Canada south to southern Lower California, Mexico, and the South Atlantic states; winters from Oregon, the Ohio Valley, and the southern Middle Atlantic states south to the West Indies, Panama, and the Galápagos Islands.

Seen on the edge of marsh or river near sunset, the great blue heron presents a picture. It waits motionless on its stiltlike legs, head drawn in between its shoulders. When a small fish, frog, or insect comes its way, it snaps suddenly with its strong, sharp bill. Then it resumes its solemn sphinxlike waiting. If disturbed, it flaps off slowly into the deeper marsh or denser pasture. As it trails off it utters a single harsh rasping squawk.

Though the blue heron is a solitary feeder, it is by no means a hermit. Colonies of ten or fifteen pairs return year after year to the same heronries. Each couple simply relines with fresh twigs the platform of sticks in a tree top. The dull bluish eggs are a little larger than a hen's. Only three or four are laid. Crude though the nest is, the eggs seldom roll out. As timber is cut and swamps are

drained, the great blue heron is driven from cover. So tempting a mark does it offer by its slow flight that poor sportsmen shoot it "just for the fun of it." Certainly the bird serves no purpose dead, for it is not game. Hunters excuse this slaughter by saying that herons eat too many fish. But the fish are generally small. Frogs, tadpoles, snakes, mice, gophers, and chipmunks are also consumed. So, if the great blue heron robs the fisher, it perhaps pays the farmer by destroying gnawing pests.

LITTLE BLUE HERON

PLATE 17

Florida caerulea caerulea

LENGTH: 20 to 30 inches.

RANGE: Breeds in the eastern United States north to Kansas, Illinois, and Pennsylvania; winters from South Carolina south to the West Indies and northern South America.

Little blue herons always travel and nest in colonies. They often associate with their cousins, the snowy herons, in southern rookeries. Lacking the prized slender plumes of the pure white bird, the little blue heron escapes slaughter. Fledglings of these varieties closely resemble each other. The young of the little blue heron always have slaty-blue tips to the large wing feathers. Their legs are yellowish-green. The little blue heron is also clearly distin-



Nest and eggs of the little blue heron (left) and of the great American bittern (right)

guished from the great blue heron by its small size. Thus protected by comparative smallness and no special claim to beauty, it survives, while its showier relatives must die.

The little blue heron's home is a platform of sticks. The nests, in communities of a dozen or more, are generally placed in bushes over watery hunting grounds. The eggs, pale blue in color, number three or four. When feeding, little blue herons are silent. They wait for their prey to come within striking distance. Frogs, toads, tadpoles, and small fish are quickly and quietly speared and devoured. Often after feeding, flocks return to their rookeries. There, when undisturbed, they chatter in strange croaking voices. After nesting duties are over, the little blue heron casually wanders northward into Canada.

GREAT AMERICAN BITTERN

PLATE 17

Bolaurus lentiginosus

LENGTH: 24 to 30 inches.

RANGE: Breeds from Virginia northward to northern Canada; winters from Virginia south to the West Indies and Guatemala.

The great American bittern is commonly called "thunder pump" or "slough pumper." Its cry has been compared to the working of an old-fashioned wooden pump. "Pump-er-lunk, pump-er-lunk," it calls in deep booming tones from marsh, swamp, or grassy meadow. It is more often heard in the spring. After the sedges are fully grown, it is almost impossible to discover the bird. What appears to be a slender stump in the grass suddenly comes to life. Slowly it spreads its large broad wings and leisurely rises. Then languidly it flaps in its flight above the rushes and sedges. When danger threatens, it puts up a stiff fight. Let an intruder approach too closely, and a thrust from a sharp beak and a slap of stiff wings soon show which is master of the situation.

The American bittern may stand motionless for hours waiting for food to come its way. Beak pointed upward, it blends into a background of reeds. Then pounce! It spears frog, fish, or large insect. A slow tramping gait makes the bittern look lazy, but it is far from indolent. It searches the muddy pools for shellfish which it treads out with its toes. Bitterns move about alone, and only during the nesting season travel in pairs. Both parents keep near the nest of grasses placed on the ground among cat-tails and rushes.



PLATE 17.
Little Blue Heron
Bittern

© Painted expressly for THE CLASSROOM TEACHER
Great Blue Heron



PLATE 18.

© Painted expressly for THE CLASSROOM TEACHER

Wilson's Snipe
Upland Plover

Killdeer Plover

KILLDEER

PLATE 18

Oxyechus vociferus vociferus

LENGTH: About 10½ inches.

RANGE: Breeds throughout the United States and most of Canada; winters from the central United States south to the West Indies and northern South America.

Distinguished by its piercing "Killdee-killdee-dee-dee," the killdeer is one of the best known of the shore-bird family. It frequents wet and dry places alike. Decided preference is shown for muddy pools or newly plowed fields. Often, laying its eggs in a field before it is plowed, the killdeer is forced to repeat its effort at rearing young. No wonder it makes no attempt to build a nest. It deposits four yellowish-white eggs, scrawled with brown, directly on the ground.

Moving about daintily, quickly, and nervously, it constantly gives chase to beetles, grasshoppers, and insects of cultivated lands. As worms are also a tidbit, it feeds by night as well as by day. Among the beetles consumed are such pests as corn-damaging billbugs and weevils that infest cotton boll, clover root, and alfalfa. Always on the alert for intrusion, the killdeer voices its fear at the slightest approach of huntsmen. Thus its cry becomes the sentinel alarm for other birds. Duck hunters often kill the killdeer in sheer aggravation. Though noisy and restless, the killdeer's activities result in benefit to stock and crop. This alone should be enough to insure its protection.

UPLAND PLOVER

PLATE 18

Bartramia longicauda

LENGTH: About 12 inches.

RANGE: Breeds from northwestern Alaska, southern Mackenzie, central Keewatin, Wisconsin, Michigan, Ontario, and Maine to southern Oregon, northern Utah, Oklahoma, southern Missouri and Indiana, and northern Virginia; winters in South America.

The upland plover is really a sandpiper. It is known in some regions as Bartram's or the Bartramian sandpiper. It has four toes, while the true plover has but three. It inhabits grassy plains and pastures. Upland plovers resemble dried grass so closely that many



Nest and eggs of the killdeer

may feed on the prairie without attracting attention. Choosing a grass-lined depression, generally at the foot of a small bush, the plover lays four unusually large eggs. They are creamy-buff or white, spotted with reddish-brown or chocolate. So well concealed are they in the grass that they generally escape discovery.

This sandpiper may be easily recognized by its common call note, "Quitty, quit." It is uttered in a soft, sweet tone. Late in spring a long mournful whistle like that of the wind may be heard. Often upon alighting, the upland plover folds its wings straight upward. Then folding them down slowly and gently, it utters a long mellow call. By nature the upland plover is unsuspicious. Though it has become cautious and shy through persecution, it is unafraid of horses. Hunters on horseback have shamelessly shot down upland plovers until they no longer appear in great numbers.

The upland plover is a glutton for grasshoppers. During the grasshopper years in Iowa, Minnesota, and Nebraska, it was reported to be the most important enemy of this Rocky Mountain locust. It is also a great foe of the cotton-boll weevil. It greedily eats crickets, billbugs, horse flies, and cattle ticks. Though removed by the federal law from the list of game birds, this helpful bird is still hunted in some sections. Great effort should be made to have the law rigidly enforced, for it injures no crop, but consumes a host of the worst enemies of agriculture.

WILSON'S SNIPE

PLATE 18

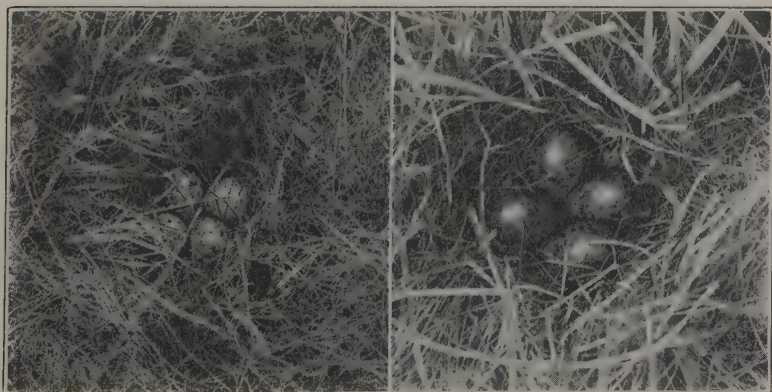
Gallinago delicata

LENGTH: About 11 inches.

RANGE: Breeds from northern United States to northwestern Alaska and central Canada; winters from northern California, Arkansas, and North Carolina south to the West Indies and northern South America.

One of the early signs of spring is the whistling of the snipe's wings, at dawn or by moonlight. Mounting high in air, the snipe drops earthward with great speed. It is thought that the air rushing through its wings produces the whistling sound. This sound is also described as a bleating, and is peculiar to the mating season. The Wilson's snipe travels singly. It frequents damp meadows and fresh-water marshes, which offer it food and security. The arrival of the snipe may be guessed by clusters of holes in the boggy soil. These are made by the bird's probing its sensitive bill into the wet soil for worms and larvae of insects. The snipe is largely a nocturnal bird. It is by night that earthworms come to the surface. The nest is invariably placed in a hollow on the ground, in a marshy place. Usually four eggs are laid; they are brownish-gray, heavily marked with chocolate.

The snipe is a cautious bird, and it rarely leaves the shelter of the grasses, which in color it closely resembles. Few are familiar with the bird itself. It is known chiefly by its call, a harsh "Scaip, scaip."



Nest and eggs of the upland plover (left) and of the Wilson's snipe (right)

This it cries as it rises, when suddenly roused by a hunter. Thanks to a swift zigzag flight, it usually escapes. Snipe-hunting is very uncertain. Bogs alive with snipe one day may be almost deserted the next. Marshes which afford good shooting one season may be worthless the following season. The continuance of spring shooting will mean a steady decline in number and in time will lead to the extinction of the snipe. This is indeed shortsighted in the case of a bird highly prized as game.

SPOTTED SANDPIPER

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Actitis macularia

LENGTH: About $7\frac{1}{2}$ inches.

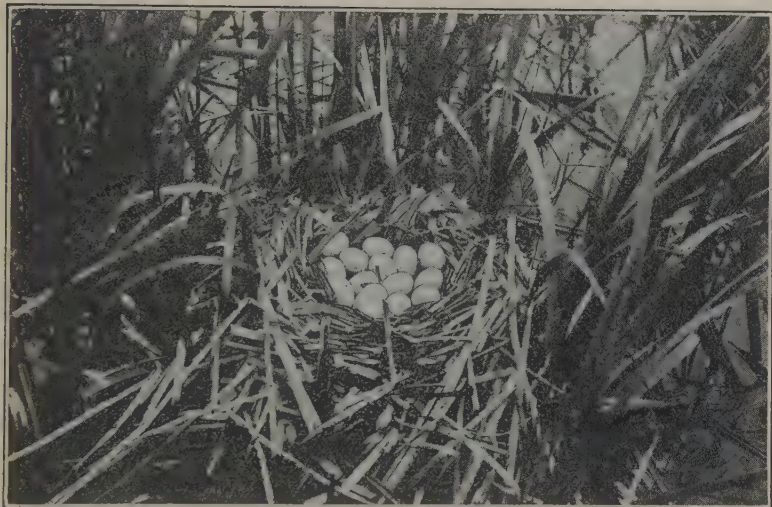
RANGE: Breeds from Hudson Bay and Alaska to South America; winters from South Carolina to Brazil.

This restless little shore bird is generally known by its quaint mannerisms. It is most commonly found inland on the shores of rivers, ponds, and lakes. During the nesting season, however, it often wanders into pastures, cultivated fields, and meadows, sometimes considerable distances from the water.

The little sandpiper has all sorts of picturesque names. It is sometimes called "peet-weet," from its note of alarm; sometimes "sand-lark," because of the mate's habit, during the nesting season, of soaring upward, singing as he goes. Sometimes it is called "tip-up," "tilt-up," or "teeter-tail," because of its habit of keeping its rounded tail teetering or bobbing up and down.

The sandpiper's nest is a simple affair, a mere depression in the ground. It is made of dry grasses and leaves, and is concealed among weeds and grasses. The four eggs are of a creamy-buff color, spotted and blotched with brown. They are always arranged in the nest with the small end of the egg toward the center. The downy baby sandpiper leaves its nest soon after hatching, and from the first bows and teeters like its parents. The flight of the spotted sandpiper is not like that of any other sandpiper. Its wings are slightly drooped as it flies and the wing strokes are made in unison like the oars of a boat. If it is suddenly roused, it has a peculiar way of skimming swiftly away down the beach. In its flight it makes a wide circle, and returns again to its starting point.

The food of the sandpiper consists almost entirely of insects, worms, and snails. It should be protected.



Nest and eggs of the American coot

COOT

PLATE 19

Fulica americana

LENGTH: 14 to 16 inches.

RANGE: Breeds from Greenland, Canada, and Alaska south to Lower California, Texas, Tennessee, and New Jersey; winters from southern British Columbia, Nevada, and Virginia south to Panama and the West Indies.

Awkward on land, the coot is expert in the water. It is an easy swimmer and a good diver. Swimming on the surface of the water, it bobs its head in unison with the strokes of its lobed feet. Like a loon, it sinks with surprising rapidity when diving for food. Often it swims under water for a long distance. Coots inhabit boggy marshes, grassy pools, and sluggish streams with reed-grown shores. They are very timid creatures. Most of their time is spent among the reeds and rushes. Were it not for their noisy voices they would escape detection. When alarmed, they give utterance to loud, high cackling notes. As they attempt to escape danger they patter over the water, using both wings and feet.

The nests of the coot are bulky structures of grasses and reeds. They are attached to living rushes, usually above water. The eggs

are light buff, speckled with black or chocolate, and vary in number from eight to fifteen. Coots are very jealous parents and will not allow any other bird near the nesting site. Young coots can swim and dive soon after they are hatched. The downy chicks often become the prey of pickerel and turtles. Coots feed on wild grain and water plants which are of no use to man. They eat snails, tadpoles, and water insects. As their flesh has an unpleasant flavor, they have little to fear from sportsmen. In fact, there seems no excuse for killing or disturbing these birds.

SANDHILL CRANE

PLATE 19

Grus mexicana

LENGTH: 40 to 48 inches.

RANGE: Breeds in southern United States northward through the Mississippi Valley to Manitoba; rare near the Atlantic coast; resident in Florida and Louisiana; winters from California and Texas south to Mexico.

Borders of sloughs in the prairies and open plains are ideal haunts of the sandhill crane. As it struts about majestically, it keeps a watchful eye for enemies. At the slightest sign of intrusion it stands motionless. When real danger threatens it spreads its broad wings. Then with a springlike motion it lifts its heavy body into the air. With flapping wings it slowly circles higher and higher until it almost fades from sight. Before alighting for food, it circles about to satisfy itself that no danger lurks near its feeding grounds. Its cry is a hard tremulous call. At close range it sounds unpleasant, not unlike a coarse cowbell. From mid-air it has a bugle-like quality.

Shortly before nesting season, sandhill cranes go through peculiar antics. "They hop and skip and circle about with drooping wings and croaking whoop." Bending and bowing they spring into the air, then fall back to earth again. Both male and female join in the dance which continues until the last crane is exhausted. The nest is usually placed in a marsh on the ground. It is a bulky mass of roots, weeds, and grasses. There are always two eggs of olive-gray color, spotted and blotched with cinnamon brown. Besides roots and berries, the food of the crane consists of a large variety of animal life. It destroys many meadow mice, shrews, and grasshoppers. Therefore, a distinct claim of usefulness to man may be made for it.



Nest and eggs of the sandhill crane

LONG-BILLED MARSH WREN

PLATE 20

Telmatodytes palustris palustris

LENGTH: About 5 inches.

RANGE: Breeds in the eastern United States and southern Canada; winters from the Gulf states south to eastern Mexico.

The long-billed marsh wren is a nervous little busybody. It delights in large marshes and the wet lowlands about the mouths of rivers where rushes and sedges abound. It rambles among the dense vegetation, flitting from rush to rush. As it flutters about it sings a bubbling, chattering song. Often before one marsh wren has ceased to sing, another takes up the refrain. Frequently the little haunt resounds with a chorus of joyous song.

The marsh wren builds a compact globular nest of dried grasses. It is suspended above standing water, between rushes, sedges, or cat-tails. The entrance of the nest is an inconspicuous opening in one side. The interior is lined with fine grasses and the silken down of cat-tails. A dozen or more nests may be found within a small area. All of these may have been built by one pair, for marsh wrens continue to build throughout the nesting season. It is thought that these additional nests, which are used only as roosting places, are constructed to prevent discovery of the occupied nest.

Marsh wrens feed chiefly on water insects in the larval stage. These larvae are easily procured as they creep up the stems of vegetation, seeking a place for transformation into the adult insect.

Crayfish, shrimps, and spiders form part of the marsh wren's diet. This bird is of no immediate benefit to the farmer. Undoubtedly it is a great aid in checking insects that harm water plants.

FRANKLIN'S GULL

PLATE 20

Larus franklini

LENGTH: $13\frac{1}{2}$ to 15 inches.

RANGE: Breeds in southern Canada and in the United States between the Rocky Mountains and the Mississippi River, south through Iowa; winters from the Gulf coast to northern South America.

Similar in size and coloration, Franklin's gull is often confused with the black-billed Bonaparte gull. It is the only inland gull with bright coral bill and legs. In the waters of marshes, Franklin's gulls breed in large colonies. On floating rafts of reeds and grasses, they build substantial nests. Lightly as swallows they skim over the water. Gracefully they capture insects that dart in and out among the sedges. No insect escapes the keen eyes of these tireless searchers. They scour the open prairies at great distances from their nesting grounds.

These gulls are very gentle and trustful. They follow the plowman in flocks as he furrows the soil. Unearthed larvae and insects are quickly seized and devoured. These gulls become tame when they are not annoyed. Early settlers of the Plains called them their "prairie doves." They feed almost wholly on insects. Dragon flies and their nymphs are tidbits. May beetles, squash bugs, and billbugs are consumed in great quantities. Grasshoppers form the bulk of the diet. The destruction of grasshoppers alone makes these gulls valuable birds of the open country.

RED-WINGED BLACKBIRD

PLATE 20

Agelaius phoeniceus

LENGTH: 9 to 10 inches.

RANGE: Breeds from Alaska and the eastern forests of Canada south to Mexico; winters in the southern half of the United States and south to Costa Rica.

Red-winged blackbirds are among the first arrivals in the North in early spring. While marshes are still frozen the advance army



PLATE 19.

Coots

© Painted expressly for THE CLASSROOM TEACHER

Sandhill Crane



Alan Brooks -

PLATE 20.

Black Tern (immature)
Black Tern (adult, summer)
Marsh Wren (prairie)

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Red-winged Blackbird
male (above) and female
Franklin's Gull

consisting of males arrives. A week or ten days later the somber-colored females follow. It is this inconspicuous plumage of brown and buff that aids their safety when later they sit upon their nests. Sloughs, ponds, and pools where rushes grow densely are favorite haunts of these birds. It is in such breeding places, which are numerous in the upper Mississippi Valley, that large flocks gather. These play havoc with the fields of oats, rye, and wheat, casting ill repute upon the redwing. East of the Allegheny Mountains where marshes are few, redwings are not numerous and little damage is done.

Although they are early arrivals, red-winged blackbirds are not early breeders. They begin to build their nests when vegetation is advanced. The nest is a deep bulky structure composed of grasses and lined with finer fibers. It is most often placed between stalks of reeds or sedges. As soon as the young are able to fly, they forage on cultivated fields. It is then that greatest damage is done. Three-fourths of the food is vegetable matter. It consists of weed seeds, grain, and some small fruits. Animal food consists largely of harmful insects. The red-winged blackbird shows preference for beetles, caterpillars, army worms, cutworms, and spiders. In regions where the redwing is not numerous, the balance is in its favor. But where large flocks make great inroad on grainfields, it is a serious problem.

BLACK TERN

PLATE 20

Hydrochelidon nigra surinamensis

LENGTH: About 10 inches.

RANGE: Breeds from central Canada south to California, Colorado, Missouri, and Ohio; migrant in eastern United States; winters from Mexico to South America.

The black tern breeds in large colonies in the marshy edges of rivers and fresh-water lakes. It makes no effort to build a nest. Sometimes the two or four olive-brown eggs are laid upon the damp marshy ground. Sometimes they are placed on a muskrat's house. A floating mat of reeds and grasses often holds them. The black tern spends little time in hatching the eggs. Incubation is left largely to the sun. Black terns are faithful parents when hungry nestlings clamor for food.

Hundreds of dusky terns skim over the marshlands searching for insect food. Flying gracefully and lightly about, they dart to and

fro in pursuit of sighted insects. Dragon flies, damsel flies, May flies, beetles, gnats, and grasshoppers, they constantly pursue. They feed extensively on enemies of fish, such as dragon-fly nymphs, fish-eating beetles, and crayfish. Fish form a small part of the diet; those eaten are minnows and mummichogs, which are of little value. This tern, unlike most of its family, is a beneficial insect destroyer. After the nesting season, both old and young lose much of their dusky color. It is then, in its plumage of gray and white, that the black tern is often confused with the least tern. Yellow bill and legs distinguish the latter species.

SNOW GOOSE

PLATE 21

Chen hyperboreus hyperboreus

LENGTH: 23 to 28 inches.

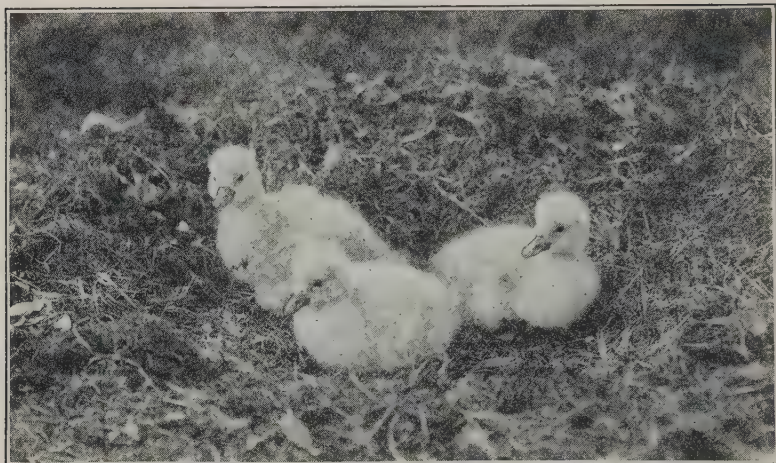
RANGE: Breeds in Alaska, and in Canada from the mouth of the Mackenzie Valley east to the Hudson Bay region; winters from southern British Columbia and southern Illinois south to Lower California, central Mexico, Texas, and Louisiana.

The lesser snow goose, or white brant, is now chiefly a western bird. It most often frequents the Pacific coast, though it wanders eastward to the Mississippi Valley. In the early days of California, snow geese settled on the stubble in such numbers that it resembled great fields of snow. At a distance, the white brant when in flight is easily confused with the Canada goose. Observation reveals two signal differences: Canada geese fly in a V-formation; lesser snow geese, in irregular masses. Then, too, the high-pitched cackling of the snow goose cannot be confounded with the mellow honk of the Canada goose. Other traits, however, are similar.

The nest of the snow goose is a depression in the ground, lined with gray down. There are from five to seven eggs of a dull-white or creamy-white color. The white brant observes the morning and evening meal with punctuality. It is very cautious. Sentinel on guard, it feeds on herbage in fields or on roots among rushes in the marshes. Its frequent visits to fields of grain have led to its downfall. The first nipping of blades of growing grain does little damage. Indeed, there are some who claim that the crop stools the better for it. No doubt real damage results from too frequent cropping. Nevertheless, shooting the lesser snow goose is rapidly exterminating a game bird noted for flavor as well as for beauty.



Above, left to right, are shown the nests and eggs of the Franklin's gull and the red-winged blackbird. Below are those of the long-billed marsh wren and the black tern



Nestlings of the whistling swan

WHISTLING SWAN

PLATE 21

*Olor columbianus*LENGTH: About $4\frac{1}{2}$ feet.

RANGE: Breeds in northern Canada about the Arctic Ocean; winters southward to the Gulf of Mexico. (It is more abundant in its western range.)

Like the domestic swan of city parks, the whistling swan presents a stately white appearance, but it is not half so sedate in voice. Its unmusical notes vary with the bird's age. Some resemble the bass of the common tin horn, others the falsetto of a clarinet. A flock of flying swans against a blue sky is a beautiful and thrilling sight. With necks extended and wide wings fanning the air, they sail gracefully along. They have been compared to a racing fleet of yachts under full sail. A clarion-voiced veteran leads the wedge formation. Sometimes their speed is almost unbelievable. Their flight, with the wind, has been estimated at one hundred miles an hour.

Whistling swans nest on the ground about lakes and islands. Gathering a mass of sticks, weeds, and water plants, they build a pile nearly two feet high and six feet across. This they line with down. The male assists in building the home, for he is a faithful mate and father. From three to six rough greenish-buff eggs are

laid in June. Endowed by nature with a long neck, the swan can easily probe the bottom of pond or lake for shellfish, frogs, tadpoles, worms, and roots of water plants. Formerly, whistling swans were numerous. Indians of the North awaited their return. Soon after the wild geese arrived, they prepared to trap the swans for their down. They had learned from observation that swans follow in the wake of wild geese. Thousands of pounds of down were sold to the Hudson's Bay Company. Perhaps this accounts for the fact that so few whistling swans follow the spring flight of the geese.

CANADA GOOSE

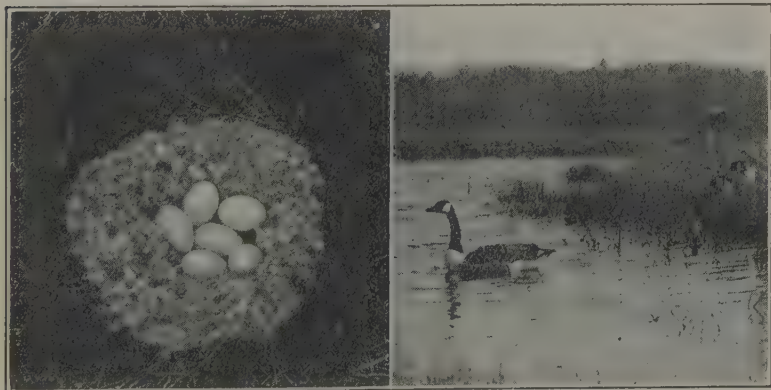
PLATE 21

Branta canadensis canadensis

LENGTH: 35 to 43 inches.

RANGE: Breeds in central and southern Canada and in the northern United States; winters from southern British Columbia, southern Wisconsin, southern Illinois, and New Jersey through southern California, Texas, and Florida, and south to Mexico.

The "Honk, honk, k'wonk" from a flying V-formation of Canada geese is said to warn of winter. Flocks go and come, however, from September until early spring, when most go North to nest. Ordinarily they alight for any length of time only on the larger lakes. At mealtimes and during foggy or stormy weather they seek ponds and marshes of aquatic grass, insects, and small fish. Or they penetrate cautiously inland to find grain among a farmer's stubble.



The Canada goose, with its nest and eggs

They wander into leafy pastures for buds and berries. After a good supper they return to the water, where they float about all night, head tucked under wing. At daybreak, another flight must be made inland for breakfast. The two regular daily flights are characteristic of all geese. Hunters count on this punctuality. But the Canada goose is nobody's fool. No game bird has a keener, more suspicious eye, unless it be the sandhill crane. No one can appreciate the expression "wild goose chase" until he has hunted Canada geese. While thrown into panic by dog or man, the Canada goose shows no fear whatever of cows. Gunners often hide behind cattle to get within range.

In different regions the nesting habits of Canada geese differ. They nest on islands in lakes and in the marshy portions of sloughs. The island nest may be merely a depression in the bare ground, lined with sticks, straws, and a quantity of down; the slough nest may be built entirely of dead flags. There are from four to ten creamy-white eggs.

It is possible to domesticate Canada geese and to cross them with the common barnyard goose. For several generations, however, wild ganders must be introduced so that the flock will not degenerate. It is also necessary to clip the wings in the spring and fall, lest the captive geese rejoin wild flocks.

GREEN-WINGED TEAL

PLATE 22

Nettion carolinense

LENGTH: About $14\frac{1}{2}$ inches.

RANGE: Breeds from northwestern Canada, central Keewatin, and Newfoundland south to central California, northern Nebraska and Illinois, and the southeastern border of Canada; winters from British Columbia, Nevada, Indiana, and Rhode Island south to Lower California, Cuba, and Honduras.

Formerly numerous throughout its range, the green-winged teal is no longer seen in large numbers in the Atlantic region. This handsome little duck shows marked preference for ponds, marshes, and rush-grown shores of streams and lakes. It keeps well hidden in grasses until evening. Large flocks feed contentedly in small waterways when not disturbed. The green-winged teal is less shy than most of its kin. Farmers frequently find it feeding on corn with barnyard fowl. It has been found nesting near a railroad track



PLATE 21.

Snow Goose
adult and young

© Painted expressly for THE CLASSROOM TEACHER
Whistling Swan
Canada Goose



Allan Brooks.

PLATE 22.

Mallards
female—male

© Painted expressly for THE CLASSROOM TEACHER
American Mergansers (female—male)
Greater Scaups (female—male)
Green-winged Teal

where laborers were busily working. Though swift of wing and fleet of foot, it is fast decreasing in numbers. It is one of the easiest ducks to decoy. Curiosity leads it into the open to investigate, thus making it a good mark for sportsmen. Then, too, survivors repeatedly return to fallen comrades. Fortunately, the green-winged teal is a mark for experts only, so suddenly does it rise when flushed.

In sections where the teal has fed on wild oats or soaked rice, it is prized as a delicacy. But in the salmon regions, where it often feeds on decaying fish, it escapes persecution. The teal rarely dives for food, for its feeding-grounds are shallow water. It dabbles with its bill upon the surface of the water for bits of food, or "tipping up," it probes the bed of stream or pond for crayfish, snails, insects, and roots of plants. The nest of the teal is placed on the ground in the shelter of tall grasses. It is built of weeds and grass, lined with gray down. The buff-colored eggs number six to twelve. As the teal is a good walker, it is not uncommon to find a nest at some distance from running water.

AMERICAN MERGANSER

PLATE 22

Mergus americanus

LENGTH: Male, 25 to 27 inches; female, 21 to 24 inches.

RANGE: Breeds from Alaska, Yukon, central Keewatin, and Newfoundland south to central Oregon, South Dakota, Michigan, and New England, and in the mountains south to northern California, northern New Mexico, and Pennsylvania; winters from Aleutian Islands, British Columbia, Idaho, northern Colorado, southern Wisconsin, and New England south through the United States and in Bermuda.

The American merganser, or goosander, is the largest of the saw-billed ducks. This handsome swimmer, unlike the little green-winged teal, avoids any well-settled region. Cold and ice hold no terrors for it. It prefers foaming mountain torrents and the cold waterways of the North. There it fishes and breeds. It enjoys equally salt and fresh water.

This duck is an extremely difficult mark for sportsmen for it is a swift, deep diver. Nor does its muscular flesh offer any great prize. Hunters despise the fish ducks. They consider them unfit for food, as they have a rank fish flavor. The merganser has been accused



Nest and eggs of the mallard (left) and of the American scaup (right)

of doing serious injury to food fishes, especially trout. It is an extensive fisher, but it is doubtful whether it catches many trout. However, little injury is done to fish of any kind, for mergansers migrate in small flocks of six or eight. Besides fish, the merganser feeds freely on crayfish and water insects. It lays fewer eggs than most of the other ducks. The nest may be placed in the usual duck place—on the ground among rushes—but it is more often lodged in the hollow of a tree or in a hole in a cliff. The merganser has learned to care for its own safety; it is holding its own very well.

GREATER SCAUP

PLATE 22

Marila marila

LENGTH: 18 to 20 inches.

RANGE: Breeds from Aleutian Islands and central Keewatin to the southern Canadian border; winters southward from Canadian border to Guatemala.

“Scaup” sounds like an awkward name. The duck that bears it is, indeed, an awkward fellow. So ungainly is it in waddling that it is often called “shuffler.” How the scaup received its name is uncertain. It may have come from the harsh, discordant cry which the scaup occasionally utters when suddenly alarmed or excited. Or it may refer to the shellfish scaup, upon which the duck feeds. In many places the scaup is called by the fitting name, “greater bluebill.” It is a duck of bays and mouths of rivers. It prefers salt

water, deep enough for diving. It never dabbles for food, but loon-fashion, lunges under the water for crayfish, crabs, snails, roots of wild celery, and wild rice. It is an habitual diver and is excelled only by the loon. Its readiness to dive under a raft, rather than to swim around it, is most annoying to sportsmen.

Scaups feed chiefly by daylight, but moonlight often calls them out to an unusually late supper. When feeding or caring for ducklings, they call to each other in a soft purring whistle. The nest, a soft cradle of grass and feathers, holds six to eleven rich olive-buff eggs. It is placed on the ground in a marsh. Not until the nesting season is over are scaups found on the seacoast.

MALLARD

PLATE 22

Anas platyrhynchos

LENGTH: 22 to 25 inches.

RANGE: Breeds from Pribilof Islands, central Canada, and Greenland south throughout most of the United States; winters from Aleutian Islands and southern border of Canada south to Mexico, the Lesser Antilles, and Panama.

The mallard is the wild duck of the world. From it nearly all of the domestic varieties have been derived. It is a marsh, river, and



Courtesy, U. S. Forest Service

A flock of ducks on a national game preserve in Oklahoma

pond duck. Its nest is placed on the ground, well concealed, near the water's edge. It is built of grasses thickly lined with down from the bird's breast. The olive-buff eggs range from eight to fifteen.

The mallard obtains its food by dabbling and wading. It dives to escape danger, seldom to gather food. Stretching its head under water and tipping its tail upward, it searches the oozy bottom for worms, mollusks, and roots of plants. Well screened by tall rushes, the mallard feeds quietly on wild grains and seeds. It has the habit of wandering into the stubble. Corn dropped in the field is a favorite grain. In rice-growing regions the mallard performs a real service. It gleans the red rice, which, if left to sprout, proves harmful to the main crop. Furthermore, it feeds greedily on crayfish that injure dikes and levees. It is also an aid in destroying grasshoppers and army worms.

Mallards are timid and cautious. They rarely venture into the open before twilight. Then under cover of darkness they paddle about until dawn sends them back to places of shelter. At the first quack of alarm, the whole flock springs up. Rising aslant into the air, they fly away at tremendous speed. The mallard is as inquisitive as it is wary. A painted decoy or a fluttering gay cloth excites its curiosity. This leads to its downfall. Mallards breed fairly well in captivity. Owners of large estates can do a good service by raising mallards on their ponds to set free in wild places.

Ellen P. Downing

HOW TO ATTRACT BIRDS¹

SCHOOL grounds are often bare and uninviting. How much better to clothe, shade, and adorn them! Flowers, shrubs, and trees will make the pupils more contented, inspire them to better work, and enshrine the school grounds in their memories as a place delightful to recall in later years.

Almost everything done to beautify the grounds will help to attract birds. Birds, trees, and flowers are in themselves a valuable educational resource and supply contacts which are necessary to classes in nature study. Building and placing bird houses could well be a part of the nature course in the winter. The feeding of the birds will attract living objects for the pupils to study during the dormant season of the trees and shrubs. If the children's early steps are guided in the right direction they will protect and encourage the birds.

The means of increasing the number of birds about the school and about the home are few and simple; adequate protection, provision of suitable nesting places, food, and water are all that is necessary.

WATER SUPPLY

It is all important, especially during hot weather, that drinking and bathing places be provided for the birds. The water supply should be a pool not more than a few inches deep, the bottom sloping gradually upward toward the edge. The bottom and edge should be rough so as to afford safe footing. A large bath may be made of pottery or concrete (Fig. 1). The bird bath should be elevated so that skulking enemies cannot approach too near. In the northern sections during the winter the water should be warmed so as to delay freezing. It is not necessary to make expensive baths. Pie tins or even tin cups will serve the purpose.

¹Compiled from information and statistics furnished by the United States Department of Agriculture.

SUPPLYING FOOD FOR THE BIRDS

Food supply is the vital factor in bird life and the most important single offering that can be made to attract birds. The particular food may be supplied in two ways: by planting trees, shrubs, and herbs which produce seeds relished by the birds, and by exposing food in artificial devices, especially during the winter season.

ARTIFICIAL FOOD. During the season when the natural food supply is scarce, birds respond most readily to our hospitality. Winter feeding has become very popular in many schools and homes. Children should be encouraged to practice the same hospitality toward the birds in the homes that they do in the schools.

The winter foods commonly used include suet or other fat, pork rinds, bones with shreds of meat, cooked meat, meal worms, birdseed, buckwheat, bread, crackers, coconut meat, cracked corn, millet, nut meats (especially peanuts), whole or rolled oats, popcorn, peppers, and seeds of all kinds, raw or cooked.

The methods of making these supplies available to birds are as varied as the dietary itself. A device very commonly used is the food tray or shelf (Figs. 2 and 3). This may be put on a tree or pole, by a window, or at some other point about a building, or it may be strung upon a wire or other support on which it may be run back and forth. The last device is useful in accustoming



FIG. 1. Bird baths: *a*, pottery;
b, metal or concrete



FIG. 2. Food tray

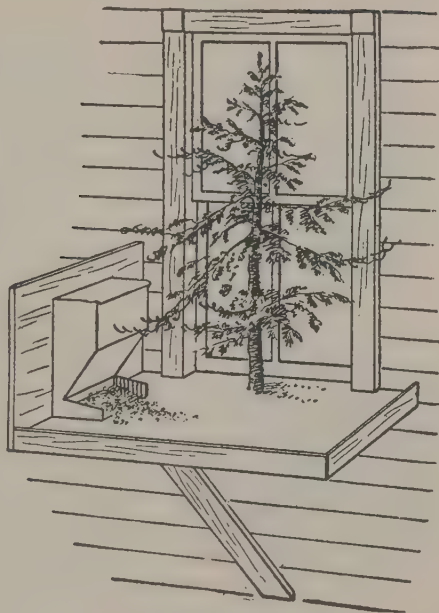


FIG. 3. Food shelf

birds to feed nearer and nearer a comfortable observation point. A fault with food shelves is that wind and rain may sweep them clean and snow may cover the food. These defects may be obviated in part by adding a raised ledge about the margin or by placing the shelf in the shelter of a wall or shielding it with evergreen branches on one or more sides.

Feeding devices not affected by the weather are preferable. An excellent one is a coconut with a hole made in one end (Fig. 4). The cavity is filled with chopped suet and nuts or other food mixture, and the nut is suspended by a wire from a limb. The size of the hole regulates the character of the guests; if small, large birds cannot gobble the supply. The coconut meat as well as the stuffing is eaten. Cans with small openings may be substituted for coconuts. Food baskets of any desired size made of wire netting or a metal



FIG. 4. Coconut larder

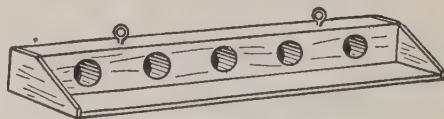


FIG. 5. Feeding stick

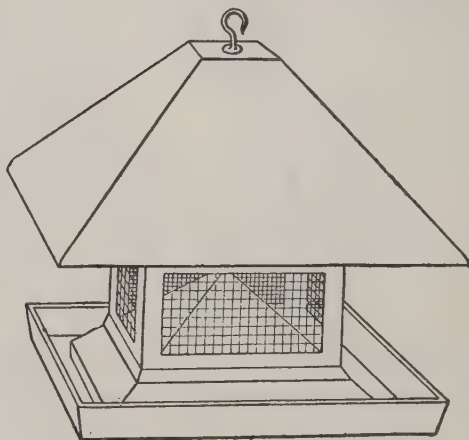


FIG. 6. Food hopper (roof detachable)

grating may be hung up or fastened to the trunk of a tree. Food mixtures in melted fat may be poured into holes made in a branch or stick (Fig. 5) or in cracks of bark or over evergreen branches. All of these devices minimize or counteract the disturbing effects of stormy weather.

More elaborate apparatus for the same purpose comprises various forms of food hoppers (Figs. 3 and 6) and food houses. The food hoppers in common use for domestic fowls are adapted to the feeding of birds, and some special forms are now manufactured for wild birds.

The food house is a permanent structure, with solid roof, and glass on one or more sides to permit observations (Fig. 7). The food trays it contains are entirely sheltered from the weather. In one style this result is obtained by mounting the house on a pivot and furnishing it with vanes (Fig. 8) which, if large enough, keep the open side always away from the wind.

We may provide game birds and sparrows with feeding places by erecting low hutches or making wigwam-like shocks of corn or grain sheaves under which food may be scattered. The opening should be to the south.

Those who desire to have birds about their homes should not feel that their power to attract them is gone when winter is over. Winter feeding easily passes into summer feeding, and experience proves that some birds gladly avail themselves throughout the year of this easy mode of getting a living.

NATURAL FOOD. We have thus far considered ways of feeding birds tidbits we ourselves have gleaned. We may feed them by another method, by cultivating their natural food plants and allowing them to reap the harvest in their own way.

Less has been done in this respect for the true seed-eating birds than for those fond of pulpy fruits. The reason is

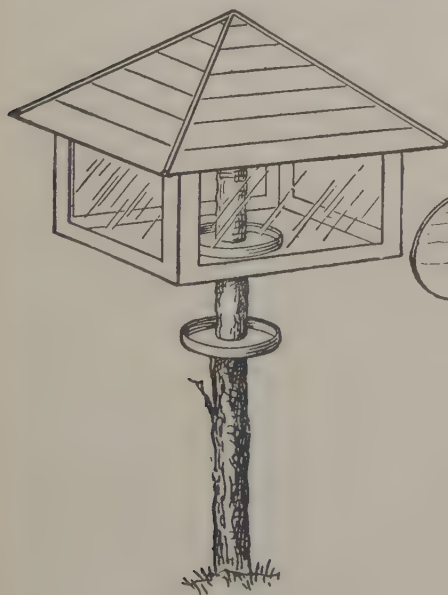


FIG. 7. Food house

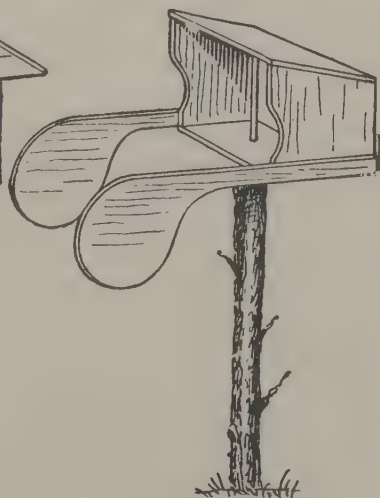


FIG. 8. Food house on pivot

obvious—our seed-eating birds largely patronize weeds, which we do not wish to cultivate, while the fruit-eaters depend upon many plants which we hold in such esteem for their ornamental value that they are generally cultivated.

Feeding seed-eating birds. Something can be done, however, to attract the seed-eaters about our homes. A number of commonly cultivated annual plants, belonging to the same groups as those upon which the birds feed extensively in nature, produce good crops of seeds. These plants, being dependent upon cultivation, can be used without fear that they will become pests. The following are suggested for the purpose: prince's feather (*Amaranthus cruentus*), love-lies-bleeding (*Amaranthus caudatus*), asters, calandrinias, blessed thistle (*Carduus benedictus*), centaureas, California poppies (*Eschscholtzia*), sunflowers, tarweed (*Madia elegans*), forget-me-nots, *Polygonum orientale* and *Polygonum sachalinense*, *Portulaca*, *Silene*, and "sugar cane" (sorghum varieties).

The various millets are relished by nearly all seed-eating birds. Common millet (*Panicum miliaceum*), Japanese millet or barnyard grass (*Echinochloa crus-galli*), and German millet or Hungarian grass (*Chætochloa italica*), may be obtained from most seedsmen, and should be planted in abundance by those wishing to attract granivorous birds. The height and stiffness of stalk of varieties of sorghum should make these abundant seeders valuable in winter. Japanese millet holds its seeds well, and, if planted thickly where it can grow up through a horizontal lattice work, makes a valuable cover and feeding place for winter birds. Canary grass (*Phalaris canariensis*) and various species of *Pennisetum* also are good for seed-eating birds.

Alders and birches bear in their numerous cones a supply of seeds which are eagerly sought for by redpolls, siskins, and goldfinches during the winter. Still another group of birds may be catered to by planting ashes and box elders. The winged fruits of these trees are opened and the seeds eaten by pine and evening grosbeaks, the visits of these birds being largely regulated by the supply of this kind of

food. Larches, pines, and other conifers are attractive to crossbills as well as to some of the species just mentioned.

Feeding fruit-eating birds. Feeding fruit-eating birds is best accomplished by planting selected species of fruit-bearing shrubs and trees. Through late spring and summer there is usually an abundance of insect food in addition to fruit enough for all the birds. So far as fruit alone is concerned, fall is the season of overflowing abundance; in winter the supply gradually decreases, and late winter and early spring are the seasons of actual scarcity. This is the critical time of year for many birds, and a plentiful supply of wild fruit will tide them over. Fortunately, everywhere in the United States there are some fruits that persist until there is no longer any need of them. If enough are planted, no birds able to live on this class of food should starve. The best of these long-persisting fruits are juniper, bayberry, thorn apples and related fruits, holly, and snowberry.

Table 1, pages 220 to 222, shows the relative popularity with birds of important genera of fleshy fruits.

BUILDING NEST BOXES

A well-built bird house should be durable, rain-proof, cool, and readily accessible for cleaning. Furthermore, if high standards of neatness and rustic beauty are adopted in the construction of bird houses, they may be made not only to serve the strictly useful purpose of encouraging beneficial species but also to add a touch of attractiveness to what might otherwise be a prosaic school yard.

MATERIALS. For the person wishing to construct his own bird houses, wood is by all means the best building material. In the choice of wood, an easily workable kind, as cypress, pine, or yellow poplar is preferable; the first-named is the most durable.

Where a rustic finish is not sought, paint is unobjectionable and greatly enhances the weathering qualities of bird houses. Modest tones, as brown, gray, or dull green are usually best.

TABLE 1. *Preference of birds among genera of fleshy fruits*¹

Common name	Scientific name	Number of species of birds known to eat the fruit ²	Kinds of birds among those desirable to attract, that are most fond of the fruit ³
Juniper; red cedar.....	Juniperus.....	39	Yellow-shafted flicker, starling, evening grosbeak, pine grosbeak, purple finch, cedar waxwing, myrtle warbler, mocking bird, robin, eastern bluebird.
Greenbrier.....	Smilax.....	39	Cardinal, mocking bird, brown thrasher, catbird, hermit thrush, robin.
Bayberry.....	Myrica.....	73	Bobwhite, downy woodpecker, yellow-shafted flicker, eastern phoebe, starling, meadow lark, chewink, tree swallow, white-eyed vireo, myrtle warbler, brown thrasher, catbird, Carolina wren, black-capped chickadee, hermit thrush, eastern bluebird.
Hackberry.....	Celtis.....	40	Yellow-bellied sapsucker, yellow-shafted flicker, starling, cardinal, cedar waxwing, mocking bird, brown thrasher, robin, eastern bluebird.
Mulberry.....	Morus.....	52	Yellow-billed cuckoo, red-headed woodpecker, red-bellied woodpecker, downy woodpecker, kingbird, starling, Baltimore oriole, orchard oriole, cardinal, purple finch, scarlet tanager, cedar waxwing, red-eyed vireo, yellow warbler, mocking bird, catbird, wood thrush, robin.
Pokeberry.....	Phytolacca.....	49	Mourning dove, yellow-shafted flicker, kingbird, starling, cardinal, mocking bird, catbird, hermit thrush, gray-cheeked thrush, olive-backed thrush, robin, eastern bluebird.
Spicebush.....	Benzoin.....	17	Kingbird, red-eyed vireo, wood thrush, veery.
Sassafras.....	Sassafras.....	18	Bobwhite, kingbird, red-eyed vireo, catbird, veery, robin.
Strawberry.....	Fragaria.....	46	Chewink, catbird, brown thrasher, wood thrush, robin.
Raspberry, blackberry.....	Rubus.....	118	Ruffed grouse, bobwhite, red-headed woodpecker, yellow-shafted flicker, kingbird, starling, Baltimore oriole, orchard oriole, pine grosbeak, song sparrow, fox sparrow, white-throated sparrow, chewink, California towhee, spurred towhee, cardinal, rose-breasted grosbeak, black-headed grosbeak, cedar waxwing, red-eyed vireo, mocking bird, catbird, brown thrasher, tufted titmouse, wren tit, olive backed thrush, wood thrush, robin, eastern bluebird.
Rose.....	Rosa.....	25	Ruffed grouse, sharp-tailed grouse, prairie chicken, bobwhite.
Mountain ash.....	Sorbus.....	14	Red-headed woodpecker, Baltimore oriole, evening grosbeak, pine grosbeak, cedar waxwing, Bohemian waxwing, catbird, brown thrasher, robin.
Chokeberry.....	Aronia.....	13	Meadow lark, brown thrasher.
Red haw.....	Crataegus.....	33	Ruffed grouse, pine grosbeak, purple finch, robin.
Dwarf apples.....	Malus.....	(4)	Ruffed grouse, ringneck pheasant, red crossbill, pine grosbeak, purple finch, cedar waxwing, mocking bird, robin.
Juneberry.....	Amelanchier.....	40	Yellow-shafted flicker, Baltimore oriole, cedar waxwing, catbird, hermit thrush, veery, robin.
Wild cherry.....	Prunus.....	74	Ruffed grouse, bobwhite, mourning dove, red-headed woodpecker, yellow-shafted flicker, kingbird, starling, Bullock oriole, Baltimore oriole, orchard oriole, evening grosbeak, purple finch, rose-breasted grosbeak, black-headed grosbeak, Louisiana tanager, red-eyed vireo, cedar waxwing, mocking bird, catbird, brown thrasher, olive-backed thrush, wood thrush, robin, eastern bluebird.

¹ Barberries (*Berberis*) and currants (*Ribes*) are omitted because they serve as alternate hosts of rusts attacking wheat and white pine, respectively.

² When 10 or more.

³ Included on the basis of field observation or because fruit was found in 10 or more stomachs.

⁴ Thirty-eight kinds of birds are known to feed on apples of various sorts, but it is not known just how many seek the small-fruited flowering apples, which are the best to plant for birds.

TABLE 1. *Preference of birds among genera of fleshy fruits—Continued*

Common name	Scientific name	Number of species of birds known to eat the fruit	Kinds of birds among those desirable to attract, that are most fond of the fruit.
Sumac ^a	Rhus ^a	93	Ruffed grouse, bobwhite, valley quail, downy woodpecker, red-bellied woodpecker, red-shafted flicker, yellow-shafted flicker, phoebe, starling, goldfinch, golden-crowned sparrow, chewink, white-eyed vireo, Audubon warbler, mocking bird, catbird, California thrasher, brown thrasher, Carolina wren, black capped chickadee, Carolina chickadee, wren tit hermit thrush, robin, eastern bluebird.
Pepperberry.....	Schinus.....	11	Cedar waxwing, phainopepla, hermit thrush, varied thrush, robin.
Holly.....	Ilex.....	45	Ruffed grouse, bobwhite, valley quail, yellow-bellied sapsucker, yellow-shafted flicker, cedar waxwing, mocking bird, catbird, brown thrasher, hermit thrush, robin, eastern bluebird.
Supple-jack.....	Berchemia.....	13	Mocking bird, robin.
Buckthorn.....	Rhamnus.....	16	Mocking bird, catbird, brown thrasher, robin.
Wild grape.....	Vitis.....	77	Ruffed grouse, bobwhite, pileated woodpecker, red-bellied woodpecker, red-shafted flicker, yellow-shafted flicker, kingbird, starling, cardinal, cedar waxwing, mocking bird, catbird, brown thrasher, wood thrush, veery, robin, western bluebird, eastern bluebird.
Virginia creeper.....	Parthenocissus..	39	Red-headed woodpecker, red-bellied woodpecker, yellow-bellied sapsucker, yellow-shafted flicker, starling, evening grosbeak, purple finch, scarlet tanager, red-eyed vireo, mocking bird, brown thrasher, tufted titmouse, hermit thrush, olive-backed thrush, gray-cheeked thrush, robin, eastern bluebird.
Buffaloberry.....	Shepherdia.....	16	Sharp-tailed grouse, pine grosbeak.
Silverberry, Russian olive, etc.	Elaeagnus.....	(*)	Sharp-tailed grouse, prairie chicken, cedar waxwing, catbird, robin.
Wild sarsaparilla.....	Aralia.....	14	Bobwhite, robin.
Dogwood.....	Cornus.....	86	Ruffed grouse, bobwhite, downy woodpecker, yellow-shafted flicker, red-shafted flicker, kingbird, starling, evening grosbeak, pine grosbeak, purple finch, white-throated sparrow, song sparrow, cardinal, cedar waxwing, warbling vireo, red-eyed vireo, catbird, brown thrasher, hermit thrush, olive-backed thrush, gray-cheeked thrush, wood thrush, robin, eastern bluebird.
Sour gum.....	Nyssa.....	36	Yellow-shafted flicker, starling, purple finch, cedar waxwing, gray-cheeked thrush, olive-backed thrush, robin.
Crowberry.....	Empetrum.....	16	Pine grosbeak, snowflake.
Bearberry.....	Arctostaphylos..	16	Ruffed grouse, dusky grouse, valley quail, mountain quail, fox sparrow, wren tit.
Huckleberry.....	Gaulthieria.....	35	Pine grosbeak, chewink, robin.
Blueberry.....	Vaccinium.....	67	Ruffed grouse, valley quail, kingbird, orchard oriole, pine grosbeak, chewink, cedar waxwing, catbird, brown thrasher, black-capped chickadee, tufted titmouse, hermit thrush, robin, eastern bluebird.
Mexican mulberry.....	Callicarpa.....	10	Mocking bird, brown thrasher.
Partridge berry.....	Mitchella.....	10	Ruffed grouse.
Elderberry.....	Sambucus.....	106	Valley quail, red-headed woodpecker, yellow-shafted flicker, eastern kingbird, Arkansas kingbird, black phoebe, starling, California towhee, white-crowned sparrow, rose-breasted grosbeak, black-headed grosbeak, phainopepla, red-eyed vireo, mocking bird, catbird, brown thrasher, California thrasher, wren tit, olive-backed thrush, robin, western bluebird, eastern bluebird.

^aOnly nonpoisonous species of sumac are considered.

^bData given are based entirely on field observations; total number of birds eating the various species of *Elaeagnus* unknown.

TABLE 1. *Preference of birds among genera of fleshy fruits—Continued*

Common name	Scientific name	Number of species of birds known to eat the fruit	Kinds of birds among those desirable to attract that are most fond of the fruit
Snowberry.....	Symphoricarpos.	25	Sharp-tailed grouse, evening grosbeak, pine grosbeak, varied thrush.
Black haw.....	Viburnum.....	28	Ruffed grouse, yellow-billed cuckoo, yellow-shafted flicker, starling, purple finch, rose-breasted grosbeak, cedar waxwing, catbird, brown thrasher, robin, eastern bluebird.
Honeysuckle.....	Lonicera.....	15	Bobwhite, pine grosbeak, white-throated sparrow, catbird, brown thrasher, hermit thrush, robin.

PROTECTION FROM RAIN. Roofs should be made with a sufficient pitch to shed water readily; or, if level, or nearly so, they should have a groove cut across the under face of the overhanging part (Fig. 9, *f*) to prevent water from draining back into the interior. This overhang in the average house should be from two to three inches, so as to protect the entrance hole from driving rain. The opening of the nest cavity itself may be bored at an upward slant to aid in keeping out water. A strip of metal or roofing paper often helps to make the ridge of the nest box thoroughly waterproof; flat roofs should either be wholly covered with some such material or else heavily painted. In latitudes where freezing weather is the rule in winter, bird houses will last longer if the sides are prolonged beyond the bottom of the box, thus draining off water which otherwise might freeze in the crack between bottom and sides and wedge them apart. To provide for the contingency that some water may get inside the box, a few small holes may be made in the bottom.

PROTECTION FROM HEAT. If attention be paid to the principle of cool construction, death of nestlings during periods of excessive heat may be lessened. Wood is in itself a fairly good heat insulator; but it must be remembered that the interior of the average nest box is small, and a single opening near the top permits little ventilation. One or two small auger holes through the walls near the top of the box will give a limited circulation of air without producing drafts. A double roof or a compartment above the nest

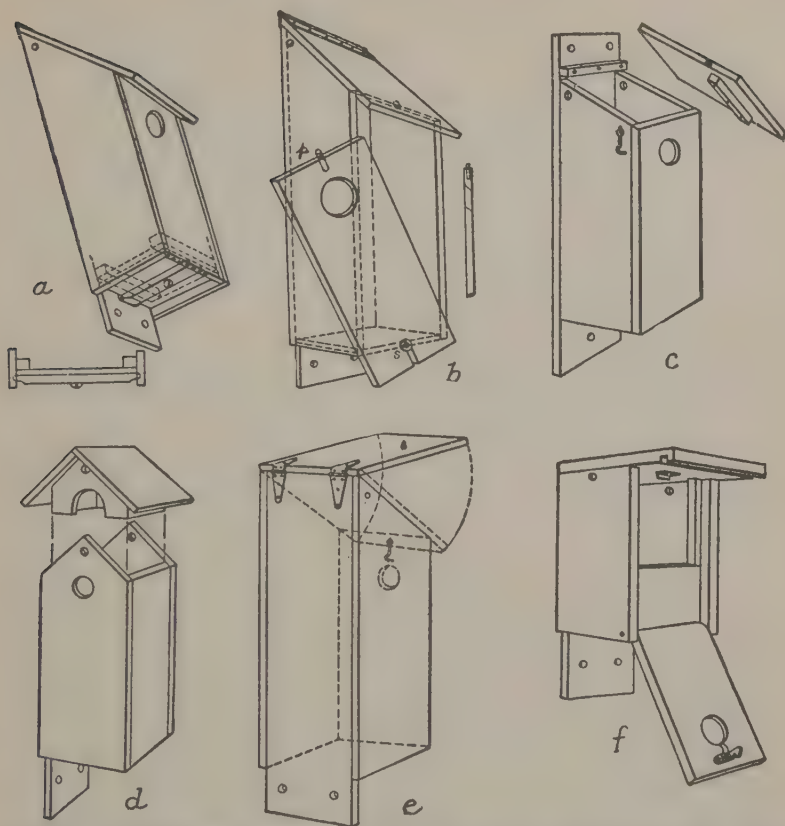


FIG. 9. Accessible nest boxes: *a*, removable bottom, released by the slight turn of a cleat; *b*, swinging front, held in place by the pin *p* and by tightening the screw *s*; *c* and *d*, removable tops; *e*, hinged top; *f*, hinged front held up by a catch

proper will also serve as an excellent insulator. In the colony houses built for martins this feature can be easily included, and the added comfort and safety afforded the nestlings will more than repay for the extra work. In martin houses, however, owing to the low position of the entrance hole and the possibility of objectionable drafts, ventilating holes in the compartments themselves should be confined to a single one of small size near the top or left out entirely.

ACCESSIBILITY. All bird houses should be placed so as to be readily accessible and built so as to be easily opened and cleaned. To those interested in studying the life history of the nestlings a readily opened box is a great aid. A number of arrangements may be used to permit inspection of the nest, several of which as applied to simple houses are illustrated in Fig. 9. A pane of glass sliding in a groove just beneath the removable side will allow observations without subjecting the birds to exposure or causing a disturbance of the nest material.

Other reasons that demand accessibility to the interior of nest boxes are mentioned in the section on Sanitation of Bird Houses, on page 238.

TABLE 2. *Dimensions of nesting boxes for various species of regular box-inhabiting birds and the height at which they should be placed above the ground*

Species	Floor of cavity	Depth of cavity	Entrance above floor	Diameter of entrance	Height above ground
	Inches	Inches	Inches	Inches	Feet
Bluebirds.....	5× 5	8	6	1½	5-10
Robin.....	6× 8	8	(1)	(1)	6-15
Chickadees.....	4× 4	8-10	6-8	1½	6-15
Titmice.....	4× 4	8-10	6-8	1½	6-15
Nuthatches.....	4× 4	8-10	6-8	1½	12-20
House wren.....	4× 4	6-8	1-6	¾	6-10
Bewick wren.....	4× 4	6-8	1-6	1	6-10
Carolina wren.....	4× 4	6-8	1-6	1½	6-10
Violet-green swallow.....	5× 5	6	1-5	1½	10-15
Tree swallow.....	5× 5	6	1-5	1½	10-15
Barn swallow.....	6× 6	6	(1)	(1)	8-12
Purple martin.....	6× 6	6	1	2½	15-20
Song sparrow.....	6× 6	6	(2)	(2)	1-3
House finch.....	6× 6	6	4	2	8-12
Starling.....	6× 6	16-18	14-16	2	10-25
Phoebe.....	6× 6	6	(1)	(1)	8-12
Crested flycatcher.....	6× 6	8-10	6-8	2	8-20
Flicker.....	7× 7	16-18	14-18	2½	6-20
Golden-fronted woodpecker.....	6× 6	12-15	9-12	2	12-20
Red-headed woodpecker.....	6× 6	12-15	9-12	2	12-20
Downy woodpecker.....	4× 4	8-10	6-8	1¼	6-20
Hairy woodpecker.....	6× 6	12-15	9-12	1½	12-20
Screech owl.....	8× 8	12-15	9-12	3	10-30
Saw-whet owl.....	6× 6	10-12	8-10	2½	12-20
Barn owl.....	10× 18	15-18	4	6	12-18
Sparrow hawk.....	8× 8	12-15	9-12	3	10-30
Wood duck.....	10× 18	10-15	3	6	4-20

¹ One or more sides open.

² All sides open.

ENTRANCES. Entrance holes for bird houses in most cases are placed near the top of the box, but if the inner side of the lumber used is dressed it should be roughened, grooved, or cleated to assist the young in climbing to the opening. Houses longer than high are comfortable and convenient, and seem to be liked by some species, particularly birds that do not have an inborn preference for the type used by woodpeckers or birds that are partial to old woodpecker holes. Perches at the entrances seem more of an assistance to enemies than a requirement for the occupants.

DIMENSIONS AND ELEVATION. The simplicity of construction of the single-room bird house does away with the necessity of detailed working drawings in most cases. Table 2 gives the proper dimensions for the various species and the height at which the boxes should be placed above the ground. The design may follow any of the types recommended in succeeding pages.

PRINCIPLES OF LOCATION OF BIRD HOUSES

E. H. Forbush, state ornithologist of Massachusetts, concluded from a statistical study of the subject that failure to attract feathered tenants may be attributed mainly to the following faults: (1) Entrance holes too small for the birds desired; (2) boxes placed in trees, and therefore accessible to birds' enemies, instead of on posts or poles; and (3) care not taken to protect birds nesting in boxes from their enemies. Houses on poles seem more acceptable than others to various birds, and this probably is because they impress the birds as being safer. Isolated trees can actually be made safe with tree guards, but perhaps they do not look so to the birds.

It is not well to have a large number of boxes on a limited area, especially those designed to attract the same species. Birds insist on territorial rights, especially in competition with other individuals of the same species, and if houses are too close together conflicts between prospective tenants may

result in none being occupied. The purple martin is our only gregarious nesting species that breeds in bird houses, and houses for colonies of these birds should be on poles well separated from trees or buildings. Tree swallows, however, are sociable and several individual boxes for them may be near together.

SUGGESTIONS FOR HOMES FOR VARIOUS BIRDS

Bluebird. The bluebird is one of the least particular of bird tenants. Any of the types of nest boxes shown in Fig. 9 will meet its needs when built to the proper dimensions and suitably located. Houses of rustic construction are also acceptable. Suggestions along this line may be found in Fig. 10. The bluebird is partial to orchards, and nest boxes may be placed either in the trees themselves or on the posts of a near-by fence, provided measures are taken to prevent attack by cats. A location rather open and sunlit is preferable. The nest material, consisting mainly of dry grasses, is procured by the bird from natural sources.

Robin. Where such natural sites as well-formed crotches are lacking, robins do not hesitate to use nesting platforms erected for them (Fig. 11). These should be either of weathered lumber or of rustic type. They should be placed in partly shaded spots along the main branches of trees or else in the shelter of the overhanging eaves of a shed or porch roof. The birds will gather their nesting material from natural sources, though in periods of dry weather one may aid them by wetting a spot of bare ground near by to serve for the mud used in the foundation of their nests.

Chickadees, titmice, and nuthatches. The needs of chickadees, titmice, and nuthatches are very similar. Being creatures of the woodland, all seem to prefer rustic homes built to simulate their natural abodes, but they will not refuse homes made of weathered lumber. Any of the types illustrated in Fig. 9, when covered with bark and built to the proper dimensions, will answer the purpose. Suggestions for rustic houses for these birds may be found in Fig. 10. Old

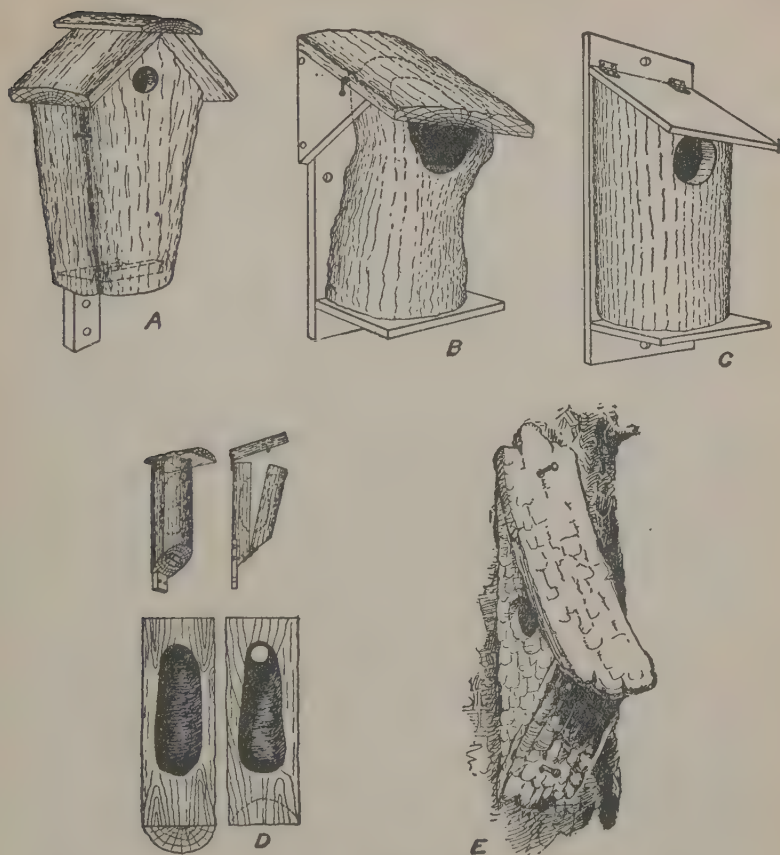


FIG. 10. Rustic boxes. *A* has a removable front; *B*, a top held by two hooks; and *C*, a simple hinged top. In *D* there is a removable top which releases the front half of the cavity in the manner pictured. The principle embodied in *B* can be applied to the type shown in *E*, made of rough slabs

orchards and the borders of woodlands are the favorite hunting grounds of these birds, and nest boxes placed in such situations are likely to be investigated. Chickadees often nest within a few feet of the ground, but nuthatches and titmice prefer a site of medium or considerable elevation. Food stations on near-by trees, providing suet and nut meats, also help to draw these birds.

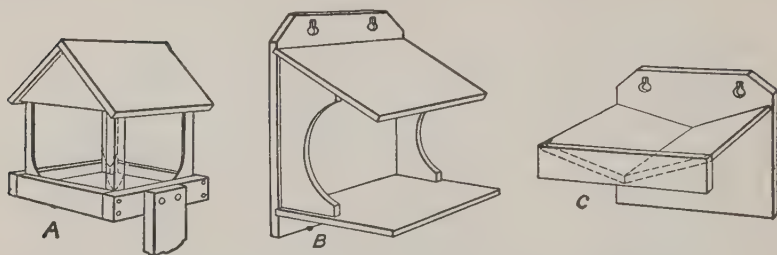


FIG. 11. Nest brackets and shelves for robins and phoebes

Warblers and creepers. Small bark-covered houses closely fitted to the trunks of trees, as suggested in Fig. 10, *E*, may be attractive to birds of the nesting habits of the brown creeper and possibly the parula warbler. Brown creepers have nested behind curved pieces of bark tacked over the bark of a living tree. Natural nesting sites for these birds must be decreasing rapidly as the older shaggier-barked trees disappear.

Wrens. House wrens and Bewick wrens are the least fastidious of our hole-nesting birds. Almost any sort of cavity will meet their needs, though boxes of small size with a horizontal slot instead of a round hole for an entrance (Fig. 12, *A* and *C*) are best. Wrens take equally well to houses of smooth lumber or of the rustic type. Longitudinal cavities (Fig. 12, *A* and *B*) make picturesque and very acceptable homes. Security for nestlings against the house cat may be provided by the structure pictured in Fig. 12, *A*, in which a passageway of variable length serves as an entrance to the nest lying below. Nest boxes of the dimensions recommended in Table 2 are better than larger ones, as it seems to be the desire of house wrens to fill with a jumble of sticks whatever cavity they select. The slot opening (Fig. 12, *C*) permits the birds to carry in cumbersome material more readily.

Almost any shady or partly sunlit spot about the doorway or orchard is agreeable both to the house and the Bewick wrens. A supply of slender twigs about three inches long handily placed will aid the birds in collecting nest

material. An abundance of wren houses is desirable, as frequently the birds will build "dummy" nests or leave one or more unfinished nests before completing one to their liking.

The Carolina wren, a somewhat larger bird, may be offered houses with slightly larger openings. It is a less familiar species about the immediate dooryard, and consequently nest boxes placed at the border of woodlands or about brushy areas are more likely to be used.

Catbirds and brown thrashers. These birds have been known to use such nesting shelters as those which are acceptable to robins (Fig. 11).

Swallows. Tree and violet-green swallows may be induced to forsake their natural nesting places in old woodpecker holes by the erection of nest boxes in suitable spots. Boxes of the types shown in Figs. 9 and 10 will answer very well for these birds when constructed to the proper dimensions. A dead tree is an excellent site for such nests, and a number of boxes may be nailed to the same stub. Bodies of water

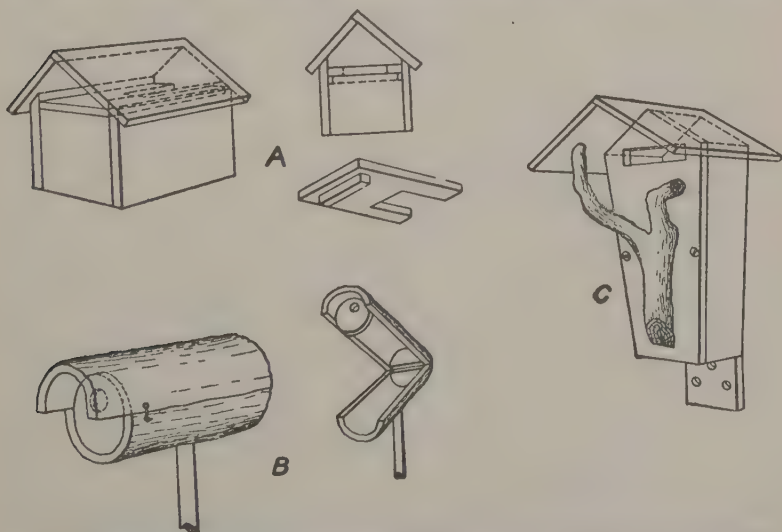


FIG. 12. Nest boxes suitable for wrens. In A the nest cavity is made accessible by removal of a notched board

hold a great attraction for swallows, and even a small pool in which they can bathe by dipping in flight will assist greatly in efforts toward establishing a colony in artificial homes. Barn swallows will avail themselves of the open or partly covered nest shelves shown in Fig. 11 (*B* and *C*) when these are placed under the sheltering eaves of buildings. Long shelves on brackets capable of supporting a number of nests will satisfy the gregarious tendencies of these birds, and similar shelves under the roofs of barns or sheds will be utilized if entrance holes are provided in the gables. One may encourage eaves swallows to nest under overhanging roofs by providing a narrow shelf or cleat of rough lumber which will give them a place of attachment for their mud nests.

Purple martin. The gregarious nesting habits of purple martins afford the builder of bird houses opportunity to employ his skill and ingenuity in construction, and in the matter of design he may let his fancy run riot. All too frequently, however, such fancies are allowed to overshadow the important factors of accessibility and coolness in the structure. Martin houses are always an attraction to English sparrows, and during the period of the year when the rightful tenants are not present the entrances to the nest cavities should be blocked or the houses taken down and stored. During the nesting season martins are apt to be successful in maintaining their property rights.

An idea that may be employed to advantage for a growing colony is illustrated in the house shown in Figs. 13 and 14. Each story is made a unit, and the uniform size permits the addition of other stories as needed. A colony may be started in one story of eight rooms. Three stories, providing twenty-four rooms, will accommodate about as many martins as would ordinarily be desired in one colony. The roof, built to the same lateral dimensions, fits to the top story, all being held together by hooks and screw eyes. Cleaning is easily done by simply taking the house apart and dumping out the débris. The temperature within the house is kept

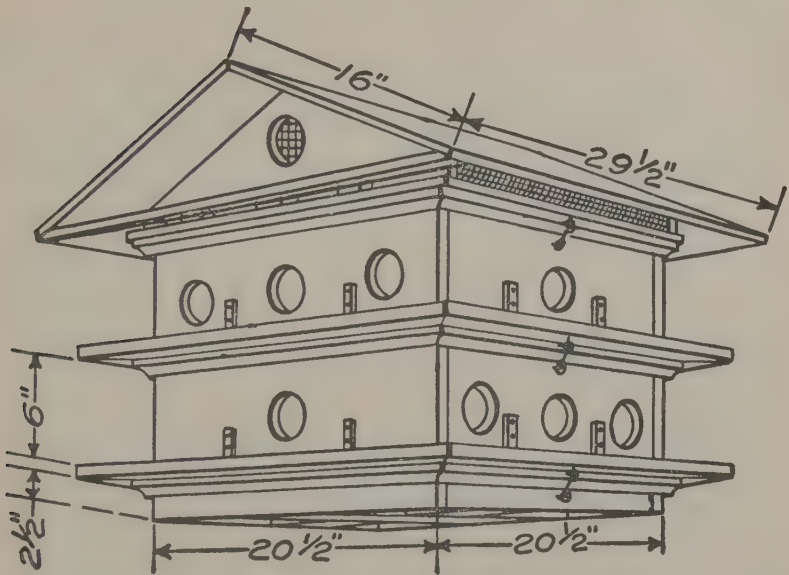


FIG. 13. Martin house in which the foundation, roof, and each story are built as units of uniform lateral dimensions, permitting the addition of more stories as the colony grows and allowing ready access for cleaning. A central air shaft and an elevated roof, permitting the passage of air beneath the eaves, assure a cool temperature for the interior. A cove molding around the underside of the roof and each story holds the parts in alignment, and pairs of hooks and screw eyes fasten the units together

down by air circulation through the passage formed by cutting out the floors of what would otherwise be central compartments. The roof, raised slightly above the top of the upper story, also permits the passage of air from the central shaft. The entire house with its support may be arranged for lowering in the manner illustrated in Fig. 15, or, if the pole is set firmly in the ground, a ladder leaned against it will permit taking down the house section by section. Such a house of two stories built of soft pine will weigh about sixty-five pounds. Houses for martins should be situated in open spaces and are usually painted white with neat trimming of a darker color. As with swallows, water has an attraction for these birds, and a pond or stream will increase the probability of establishing colonies.

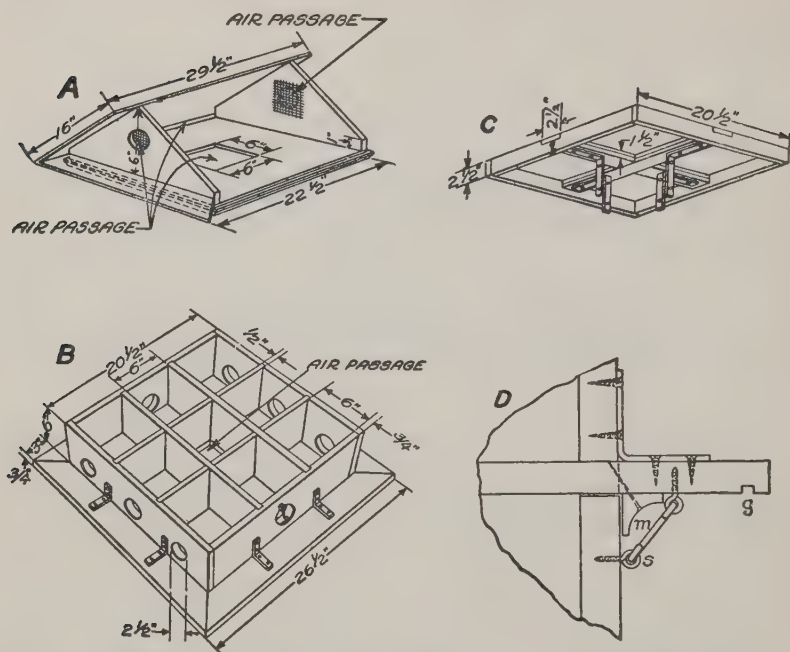


FIG. 14. Details of the martin house shown in Fig. 13: *A*, roof with one side removed to show central air shaft. Air also passes through a 1-inch slot under the eaves and through two screened holes in the ends. *B*, one of the stories. The chambers are 6 by 6 by 6 inches inside dimensions, and the bottom of the central chamber is cut out. *C*, foundation, in which the central cross is built up of double thicknesses of $\frac{3}{4}$ -inch oak and the rest of the frame is of $\frac{3}{4}$ -inch pine. Four heavy angle irons fasten this to the supporting pole. *D*, detail of the porch when attached with angle irons; the molding *m* fits about the top of the lower story; the screw eyes and hooks *s* fasten the units together, and the groove *g* is made to prevent water from draining inward

The material for the walls and floors should be three-fourths inch thick, and that for the roof and interior partitions should be one-half inch. A light-weight roofing paper cut into shingles makes an efficient and neat roof covering. When facilities for gluing are available, the three-inch porches may be made as extensions of the floors; otherwise they may be attached with angle irons as illustrated.

Song sparrows. Although a thicket usually affords all the necessities for their housekeeping, song sparrows may at

times be induced to take up their abode in a more artificial location. A covered nest shelf, as in Fig. 11, A, of weathered lumber or painted a somber hue to harmonize with the background, is advised, and should be placed in the bird's natural haunts.

Starling. European starlings readily avail themselves of artificial nesting facilities, and in areas where they are common their needs and their persistent efforts toward taking possession of what they want must be given consideration. Houses made of lumber are just as acceptable

to them as those of rustic design. Well-shaded sites are preferred, an old apple orchard being ideal from the starling's viewpoint. Although these birds are extremely wary, they show a marked preference for close association with human habitations during the breeding season. For this reason boxes erected in the dooryard are frequently occupied, though their presence there is usually rendered obnoxious by the rather careless housekeeping methods of these birds as the nestlings grow older. Boxes for starlings should be readily accessible for cleaning, an operation which is usually needed after the brood leaves. Two and sometimes three broods are reared. Any of the nest boxes pictured in Fig. 9, when built of the proper size, are acceptable.

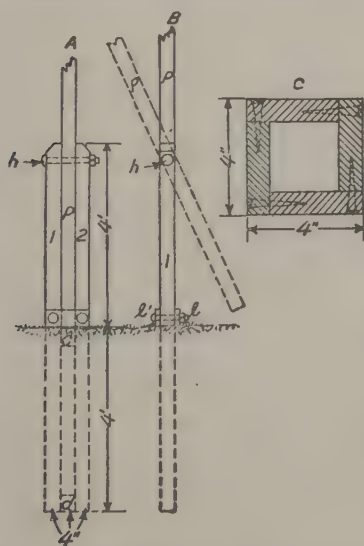


FIG. 15. Martin house pole. A and B: The supports (1 and 2) are 8 feet long and 4 inches square. They are held in alignment by the 4-inch blocks c and d and are buried 4 feet in the ground. A heavy bolt or section of pipe (h) serves as a hinge, and the base of the pole is held in position by the two hardwood blocks or iron plates (l and l') bolted together. C, cross section of pole built of $\frac{3}{8}$ -inch hardwood. In case of large houses the pole and supporting posts should be 6 inches in outside diameter

Phoebe. The phoebe, in common with certain other highly insectivorous birds, shows a liking for the vicinity of bodies of water. The broad timbers beneath a bridge are always an attraction, and when once a pair has taken up their abode in such a situation they are certain to return to it from year to year. Away from this favorite environment, nesting sites in the shape of mere shelves, as illustrated in Fig. 11, *C*, may be offered. These may be placed on the wall just within the large open doorway of the barn, or higher along the rafters, and even outside beneath the eaves, where protection may be had from above. In more exposed situations nest shelters, such as are pictured in Fig. 11, *A* and *B*, may be used.

Crested flycatcher. Very different from the phoebe's are the needs of its relative, the crested flycatcher, whose original nesting sites were old woodpecker holes and natural cavities in trees. For these holes there may now be substituted boxes made of weathered or dull-painted lumber or fashioned from natural stubs or slabs. The latter types, when placed in typical situations, as in orchards, open woodland, or in trees in pastures, probably have a greater appeal than homes made of lumber. (See Figs. 9 and 10.)

Woodpeckers. Of all the woodpeckers, flickers respond most readily to the lure of artificial nest boxes. These birds have no hesitation in using boxes of painted or weathered lumber if other conditions are satisfactory. Boxes built to proper dimensions and conforming to any of the types illustrated in Fig. 9 are acceptable. A roughened interior is preferable to a smooth one, as it permits the young to clamber up to the entrance as they grow older. A quantity of coarse sawdust, ground cork, or better, small chips, should cover the bottom of the box to the depth of one or two inches, in order that the birds may shape a cavity for the eggs. The chips also assist the birds in keeping the nest clean. Should these be neglected the birds are likely to mutilate the box in their efforts to produce their own supply. Flicker boxes should be placed above any immediately sur-

rounding foliage. A dead stub makes an excellent support for the box and even a pole of the desired height will serve the purpose. The erection of flicker boxes may be used to prevent damage by these birds, especially the western form, which often persist in drilling holes into buildings in attempting to excavate a nesting site.

The red-headed woodpecker, although preferring nest holes of its own manufacture, has been known to occupy man-made homes, those fashioned from a natural stub being most acceptable (Fig. 10, *D*). Bark-covered boxes (Fig. 10, *A* and *E*) also will serve the purpose. As in the case of flicker houses, these should be placed above the immediately surrounding foliage. These birds are especially partial to oak groves. They are prone also to drill holes in telephone poles, which may cause the latter to break in windstorms. Supplying nest boxes will afford some protection to the poles.

The needs of the downy and hairy woodpeckers are similar and vary only in the slight difference of the size of nest cavity and entrance. Boxes of the types shown in Fig. 9, covered with bark or made from natural stubs or slabs (Fig. 10), are needed. In the bottom of each should be placed a small quantity of fine chips. A bit of open woodland, or even the orchard, will furnish a desirable site for their nests, and these should be attached to the trunk of a tree not densely shaded.

Owls. Screech owls are not at all averse to using nesting facilities provided by man. Boxes of the types illustrated in Fig. 9, when made of weathered lumber and stained a dull color or covered with bark, are acceptable. A grove, or, even better, an apple orchard, furnishes excellent sites for screech-owl boxes. The birds will supply the few bits of wood and feathers needed to form a nest. It should be noted that in some instances screech owls have proved very destructive to other birds during the nesting season, but this is not believed to be true of the saw-whet and barn owls.

The little saw-whet owl will take more readily to nest

boxes fashioned from logs or those given a rustic appearance by a layer of bark (Fig. 10). Chances are best for occupancy when the box is fastened to a substantial tree in an open grove.

The barn owl, now rare throughout much of its former range, may still be found in numbers locally. It takes readily to man-made structures, often frequenting barn lofts and towers on buildings for the nesting operations. A simple wooden box (Fig. 9) of the proper dimensions will answer this owl's needs, and the birds will furnish the scanty nest material used. These boxes may be attached to the trunks of rather large trees or may be located about barn cupolas or in other little-frequented spots about buildings. For many years a pair of barn owls nested in one of the towers of the Smithsonian Institution, at Washington, D. C., in the center of an extensive park system.

Wood duck. With the continuous cutting of the older stands of timber, nesting sites for the wood duck are becoming increasingly scarce. To encourage the return of these beautiful ducks nothing more important can be done than the furnishing of nest boxes. These may be made of weathered lumber and fastened to the trunks of substantial trees. Any of the designs in Fig. 9, if made to the proper dimensions, are satisfactory. Even an ordinary nail keg with a suitable opening has served well as a wood-duck abode. Lowland timber not far from a shady stream is the wood-duck's favorite breeding ground.

PROTECTION AGAINST ENEMIES

Cats. The house cat is one of the greatest obstacles in efforts toward increasing bird life in urban or suburban communities. The mere presence of a cat, regardless of whether it is or is not a habitual bird killer, has a demoralizing effect on nesting birds and may entirely defeat the most energetic efforts to attract and increase their numbers. Young birds just out of the nest are the easiest prey for the house cat

and are likely to arouse the predatory instincts of the most docile and well-mannered. During the nesting season even the well-trained house cat must be kept away from the vicinity of bird houses, and the vagrant animal must be carefully guarded against or dealt with summarily.

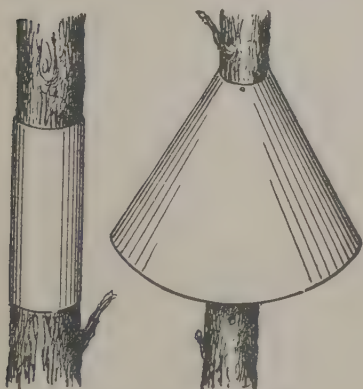


FIG. 16. Tree guards

A bird house placed on a pole or in a tree may be made inaccessible to cats by use of a sheet-metal guard. This may be either a cylinder about eighteen inches long tacked closely to the trunk, or a cone, as pictured in Fig. 16, placed high enough to prevent cats from springing from the ground and securing a hold above it. Iron pipes as nest supports are cat-proof in themselves. A far-overhanging and sloping

roof close over the nest opening also is a partial protection against cats. In some situations, wire screen of a mesh large enough to permit the passage of the bird may be used to inclose the box in such a way as to prevent cats from reaching the nest. A more effective but expensive protection involves the use of vermin-proof fences built of a strongly woven wire of not more than one-and-one-half-inch mesh. Such a fence should be about six feet high with an outward overhang of two feet at the top.

Squirrels and mice. White-footed mice and squirrels, particularly red squirrels, at times become troublesome to nesting birds. Both eggs and young birds are eaten, and in search for these the squirrels frequently enlarge the opening to the nest box. The tree guards illustrated in Fig. 16 will keep squirrels from ascending isolated trees or posts, and circlets of sheet metal placed around entrance holes will prevent them from entering boxes having openings which they must first enlarge. Some observers assert that these

metal circlets make it difficult for birds to obtain a footing at the nest hole, but this objection can be overcome by fitting them on the inside. It is well also to see that the circlets have no sharp edges or jagged projections to injure the birds.

Houses suspended on wires beyond jumping range from solid objects are immune to attacks by squirrels, cats, and mice, and are occupied by some birds. Occasionally squirrels that are particularly troublesome have to be shot.

SANITATION OF BIRD HOUSES

The desirability of having all bird houses built so as to be readily opened for inspection has been noted previously. This feature is a necessity in regions infested by the gypsy moth, as all possible hiding places for the egg masses of this species must be examined. The tussock moth and other insect pests also may place their eggs or cocoons in bird houses; and it will be to the advantage of the human owner as well as of the birds if the boxes are regularly inspected and thoroughly cleansed of all intruders, which include also mud-daubers and paper-wasps, bees, mice, and flying squirrels.

Insects can be stupefied by fumes of carbon bisulphide, carbon tetrachloride, sulphur, ordinary smoke, or the like, and disposed of as desired. The small rodents can be dumped out unceremoniously in the hope that the birds will take possession before they return; or, if it seems necessary, they can be killed.

The houses should be repaired and cleaned just before the nesting season and inspected periodically so long as birds are about. Birds are subject to parasites, some of which, as fleas, bird lice, and bird flies, are usually mere nuisances; but others, as the larvae of certain flesh flies, are a serious menace to nestlings and sometimes are so prevalent as to cause general mortality over a considerable area. Houses infested by these pests may be treated with liberal applica-

tions of derris or pyrethrum powder, special attention being given to the nest. The feathers of nestlings also can be powdered. In case the fly larvae are discovered in time, any that are actually attached to the nestlings may be removed, and a mild antiseptic may be applied to the wounds inflicted.

It is advisable to clean nest boxes immediately after broods have left, even if the parent birds show signs of using the house for another family. Old eggs and dead nestlings will thus be got rid of and the parasites of the birds kept down. The material removed should be placed on a paper and burned. After cleaning, spray the interior well with cresol to destroy any pests that may have been overlooked. On the whole, clean nest boxes have a better chance of being occupied, and certainly the prospects for rearing the next brood are improved.

So far as bird parasites are concerned sanitation of the houses can be profitably supplemented by ample provision for water and for dust or sand baths. These are nature's means of keeping down body vermin.

PROVISION OF NESTING MATERIAL

The home making of birds can be aided in many cases by the provision of nesting material. Natural materials of some sort are not so abundant as formerly, and substitutes are welcome. Rags, ravelings, and twine can be used by many birds, but short pieces only should be furnished in order to avert danger to the birds from tangling. Excelsior, straw, hay, cotton, and even hair (as used in plastering) and feathers may be supplied. A convenient way of exposing these to the birds, which at the same time prevents waste, is to use holders similar to those in which suet is placed for winter feeding; an ordinary wire broiler is excellent for the purpose. If thoroughly wet clay is made available, it will be eagerly taken by robins, phoebes, and swallows when they are building their nests.

NESTING THICKETS

Besides the birds that build their nests on the twigs or limbs of trees, in cavities of the trunk, or in nest boxes placed in trees, there are others that can be helped by providing thickets similar in character, if not in size, to those they naturally frequent. Density seems to be the most desirable feature of a bird thicket, as it gives protection from enemies. Shrubs interlaced with vines are effective and rather easily provided. In their earlier years the shrubs should be pruned so as to form numerous crotches that will support nests. The kinds of plants to use depend upon the locality; but those producing fruit eaten by the birds are most desirable, as they serve a double purpose.

BIRD REFUGES

It is hoped that the majority of school grounds throughout the country will be turned into community bird refuges. Birds appeal strongly to the interests and affections of mankind. Not only do they charm by their graceful forms, harmonious colors, sprightly actions, and usually pleasing notes, but they have an even more important claim upon our esteem because of their great economic value.

Birds feed upon practically all insect pests. They are voracious, able to move freely from place to place, and exert a steady influence in keeping down the swelling tide of insect life.

For economic as well as for esthetic reasons, therefore, an effort should be made to attract and protect birds and to increase their numbers. Where proper measures of this kind have been taken an increase of several fold in the bird population has resulted with decreased losses from depredations of injurious insects.

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MAMMALS

MAMMALS are of special interest to us because we ourselves are mammals. Like all other animals of this group we are nourished in our earliest infancy by mother's milk. Most mammals are provided with coats of hair, which serve as a protection against the cold; only in a few forms, such as the elephants and the whales, is the hair almost entirely lacking. No other kind of animal has a hairy coat, so if you find an animal covered with hair, you may be sure it is a mammal.

Most mammals are provided with four limbs, which are used in walking. In several kinds of mammals, however, some of the limbs are quite different from the usual form. In the bats the fore limbs are winglike and adapted for flight. In the whales and sea cows the hind limbs are entirely lacking, while the fore limbs are flippers. The seal has both fore limbs and hind limbs changed into flippers. A few mammals can stand or walk on the hind limbs for a very brief period, but man is the only one which regularly walks upright.

The fingers and toes of many mammals are provided with claws, which enable some to climb trees, some to dig burrows in the ground, and others to grasp and hold their food. The group of mammals called the "Primates," including the lemurs, monkeys, apes, and man, have flat nails instead of claws on their fingers and toes. The horse, cow, sheep, deer, and similar forms have horny hoofs, which protect the feet of these mammals against stony ground.

The mammals show a great range of size; the smallest are tiny shrews, some of which weigh, when fully grown, less than one-fifth of an ounce; the largest are the whales, some kinds of which are said to reach a length of one hundred feet or more. These are the largest mammals that have ever lived. The African elephant is the largest land mammal now living. It is larger than the Indian elephant, which is the one usually seen at the circus.

The mammals as a group are the most intelligent of all the animals. Although many of the more simple forms, such as the guinea pig and rabbit, are rather stupid, the higher forms, such as the dog, horse, and elephant, have a high mentality, and you have all heard accounts of their cleverness. The monkeys, and particularly the chimpanzee and gorilla, are very highly intelligent, while, as you know, man has the highest mental development of all.

A few mammals, such as wolves and monkeys, have the habit of living together in packs or bands. Together they are better able to defend themselves from their enemies, and can often assist one another in securing food or in other ways. Man is probably the most social of all animals, and the advancement he has made in civilization has been due in large part to his social habits.

You are already familiar with many domestic mammals—the dog, the cow, the sheep, the horse, the pig, and others—and no description of these need be given. In the more settled regions of North America the deer, the bear, and other large wild mammals have been driven out, but nearly everywhere some of the smaller mammals still persist, living in the patches of woodland and meadow which remain. The various squirrels and the chipmunks run about in broad daylight; in the late evening or early morning the cottontail rabbit and skunk may sometimes be seen; but many of the smaller mice, shrews, and carnivores are active mostly at night and therefore are seldom observed. However, we often can find their tracks in dusty paths or in the mud at the edges of streams, and if we search carefully, the runways of some of the mice may be found in the grass.

The following accounts are planned to aid you in identifying some of the more common mammals of North America and to tell you something about their habits. Many of the rarer forms have been omitted, since the object of this department is to give information about species which pupils may be able to study further from life.

The accounts are arranged according to the habitats in

which the various species are most commonly found, as follows:

Along lakes, streams, and in wet marshes
In meadows and prairies
On arid plains
In brushy places
In the eastern hardwood forests
In the northern fir-spruce forests
Around buildings
On high mountains

MAMMALS FOUND ALONG LAKES AND STREAMS AND IN WET MARSHES

BEAVER

SIZE: Total length, about 42 inches; tail, 16 inches long by 4.5 inches wide.

RANGE: Originally from coast to coast from mouths of the Yukon and of the Mackenzie rivers, south to the mouths of the Colorado and the Rio Grande.

“Busy as a beaver” is a common saying. No mammal works harder or is a better builder than the beaver. It builds dams and canals, cuts down trees, and constructs comfortable houses. The beaver is not a handsome animal, but it is well fitted for its work. It has a heavily built body and a flat scaly tail. The tail serves as a rudder when the beaver is swimming or diving and is used to slap the water as a danger signal. The beautiful soft fur coat, which is so valuable, is covered with long, coarse over-hairs. The beaver has short legs and its hind feet are webbed, so that it is well suited for swimming. Its chisel-shaped front teeth are very strong and sharp.

Beavers usually live and work by families. All the members of the family help in cutting down trees. With their sharp teeth they gnaw all around the trunk of a tree until it is ready to fall. When the tree is down, branches and twigs are cut off and the trunk and larger branches are cut into lengths short enough so that they can be handled by the animals. It is the bark of these trees which furnishes the greater part of their food. The sticks and other pieces of



Courtesy, Bureau of Biological Survey

The beaver's heavily built body and large, chisel-like front teeth assist him greatly in his work of building

wood, after they have been peeled of their bark, are used in the construction of dams and houses.

The entrance to the beaver house must always be in deep water. This is partly to insure safety from the attacks of predacious animals and partly so that the beaver can in winter reach its supply of food stored under the ice. If no natural deep water is at hand, the beavers construct a dam across some stream, and thus form a pond into which the tunnel to the house opens. The dam is constructed of sticks, stones, and mud. The beaver pond provides an abundance of water in which the beavers may swim to the places where food trees are growing and by which the logs and branches can easily be floated to the neighborhood of the beaver house.

The beaver house may be built on some elevation within the pond formed by the dam or on the higher ground of a bank. If high banks are available often no house at all is built but instead the animals excavate a burrow in the bank. Where a house is made, it is constructed of sticks mixed with mud. Very large houses may be as high as 15 feet and 35 feet across at the base. Inside the house is a single chamber, with a lower level where the entrance tunnel opens from below the water. This lower level is used by the beavers for drying themselves and for dining. A little above the lower level

is a dry ledge where the animals sleep. In a large house there may be several chambers, but these probably always belong to different families, and there is no communicating passage between them.

Beavers live in the same house year after year, but as repairs must constantly be made on lodge and dam and a supply of food must be gathered for the winter, each fall finds them very busy. Like the squirrels and most other rodents which do not hibernate, beavers store up food for winter. In a deep part of the pond near the house, a large quantity of green branches and logs are stored under water, being held down by mud placed on them. Here they can be readily reached by the beavers when the ice of winter prevents the animals from reaching the growing trees. Besides bark, the beavers in sum-



A typical beaver dam and house. Beaver houses are sometimes 15 feet high and 35 feet across at the base

mer eat lily roots and berries. Sometimes in settled districts they acquire a taste for green ears and juicy stalks of corn. At times they do considerable damage by cutting trees and by flooding valuable timberland. On the other hand, in some places, by forming ponds which hold the waters from the mountains and give them out gradually, they help to irrigate the land. There were once great numbers of beavers throughout North America, but they have been so much hunted for their valuable fur that they have become quite scarce. In most states they are protected by law.

A substance, known as castor or castoreum, secreted by the glands of the beaver, was formerly much used in medicine and is still used in making certain perfumes. It is also used by trappers to attract animals. Scientific name of Canadian beaver, *Castor canadensis*.

OTTER

SIZE: Total length, about 50 inches; tail, about 18 inches.

RANGE: From the northern limit of trees in North America to the southern part of South America.

The otter is more at home in the water than on land. Its long slender body, stout tapering tail, short strong limbs, and broad-webbed feet all adapt it for swimming, and it is so expert that it is



Courtesy, Bureau of Biological Survey

The back of the American otter is a rich chestnut brown, tinged with black. Its underparts are a paler, grayish color

able to catch the fastest swimmers among the fishes. In swimming, it uses its tail and hind legs in the manner of a seal or a fish and it does not kick with its hind legs as a dog or a muskrat does. Often it swims long distances under water in search of food, to escape its enemies, or merely for sport. On land it walks very clumsily, but on ice or on snow-covered ground it can proceed quite rapidly by a run and slide. Its head is round and small, with small eyes and ears. Its back is a rich chestnut brown, tinged blackish, and the underparts are somewhat paler.

Very few homes of the otter have been found in North America, but it seems to prefer to build its den in a bank under the roots of a large tree, or beneath a rocky ledge, always near a stream or lake. A tunnel leads from the den and usually opens under water. The bed, which is composed of the inner bark of trees and other soft substances, is placed in a large chamber. Here the young, usually two in number, but rarely one or three, are born about the middle of April. They stay with their mother until fall.

The otter is a very playful animal and resembles a seal in the delight it seems to take in swimming and gamboling in the water. In winter it frequents falls and rapids, for at these places it can come up for air. Often it will travel considerable distances over the snow in order to reach open water. For its amusement it slides down snow banks or slippery mud banks. Usually it selects the highest bank available and, lying on its belly with fore feet bent backward, it will glide down headforemost, often diving directly into the water. Slides as long as twenty yards are sometimes made. By constant use these slides become much worn. Audubon watched one pair of otters slide down one mud bank twenty-two times in succession. Trappers often place their traps on the otter slides, and on the next visit of the animal to the vicinity there is a good chance of his being caught.

Fish is the principal food, but frogs and crayfish are also eaten, and when hard pressed by hunger the otter has been known to eat chickens, ground-living birds, and even lambs. Its glossy fur is highly prized. The hair is very close set and has an abundant woolly underfur. For the sake of its skin it has been persistently hunted and probably would have been exterminated long ago if its cunning and shyness had not enabled it to elude many of its human enemies. Scientific name of the eastern otter, *Lutra canadensis*. Other species closely resemble it in appearance.



From drawing by Ernest Thompson Seton

Courtesy, Bureau of Biological Survey

The mink is a brownish-black color, except for occasional white spots along the undersurface of the body and on the chin

MINK

SIZE: Total length, about 24 inches; tail vertebrae, $7\frac{1}{2}$ inches.

RANGE: Northern part of the North American continent from mouths of Yukon and Mackenzie rivers south to the Gulf of Mexico and California, except in arid regions.

The mink is a first cousin of the weasel, but is much larger. It has a long slender body, with a long neck, and a broad low head. Its short ears, small eyes, and piggish snout give the mink a rather unpleasant pugnacious expression. Its legs are short, so it walks slowly and clumsily. In the water, assisted by its half-webbed toes, it is an expert swimmer. It is brownish black all over except for occasional white spots along the undersurface of the body and on the chin.

The favorite haunts of the mink are along the edges of streams, marshes, or lakes, but it is equally at home in thickets or in heavy bottomland forests. It is a restless, active creature, mainly nocturnal in its habits. It travels great distances over what seems to be a definite route along part of a river or lake system, making a circuit of this route perhaps every week or ten days.

A den may be a deserted muskrat hole in the bank of a stream or lake, a cavity among the roots of a tree, or a hollow log or stump.

In the den a nest is made of grass or leaves and is lined with feathers, hair, or other soft material. Here the four to twelve young are born in April or May. The young are blind for five weeks after birth, hairless and rather helpless little creatures, but they are quite grown up by the time they leave their mother in the fall.

The mink is a bold, courageous, and tireless hunter, often attacking animals larger than itself, such as the snowshoe hare and muskrat. Its powerful neck muscles, great agility, and quickness make it a formidable foe to any small animal. On shore it obtains for its food mice, rats, squirrels, chipmunks, birds, and the eggs of ground nesting birds and of turtles. In the water it catches fish, snakes, frogs, insects, salamanders, crayfish, and mussels. Sometimes it will raid the chicken roost of a near-by farmer, but usually it is content to take one fowl at a time, and doesn't make a wholesale slaughter, as the weasel will often do.

Adults have scent sacs at the base of the tail similar to those of the skunk. These can give off a very offensive odor, but unlike the skunk, the mink cannot throw the fluid to a distance. The fur is very valuable and mink have been killed in great numbers for their skins. Scientific name of American mink, *Mustela vison*. There are numerous subspecies.

MUSKRAT

SIZE: Eastern muskrat, total length, 22 inches; tail vertebrae, 10 inches; weight, 2 pounds 4 ounces.

RANGE: Eastern muskrat, southeastern Canada, northeastern and east central United States. Other forms are found over practically all of North America as far south as the Mexican boundary.

The muskrat bears only a slight resemblance to the house rat, but like the house rat it belongs to the order of rodents, or gnawing animals. It is a heavily built animal, with a round head, small eyes, small ears, short legs, and a long, nearly naked tail, which is scaly and flattened from side to side. The tail serves as a rudder in the water. The front feet are rather small, while the hind feet are strong, with five partly webbed toes, well fitted for swimming. The muskrat has an undercoat of soft dense fur and an outer coat, on the back and sides, of long shining hairs. The color is dark brown, sometimes almost black on the back, and gray below. A large gland secretes a musky odor which gives the animal its name.



Courtesy, Bureau of Biological Survey

The muskrat is a dark brown color, sometimes almost black on the back. The undersurface of the body is gray

The kind of home the muskrat builds depends upon the nature of the region in which it lives. Along streams or lakes with high banks it merely digs a burrow in the bank. In marshes about shallow lakes or sluggish rivers it builds a house mostly of cat-tails, mud, and grass, similar to but smaller than that of the beaver. There is always an entrance under water, and within there is a chamber above the level of the water where the animals eat and sleep. There are several litters of from four to twelve young each season. They are born blind, naked, and helpless.

The muskrat does not hibernate, but in winter swims under the ice in search of food. It works and hunts for food mainly at night, though occasionally it moves about during the day. It feeds upon the roots and stems of plants, fresh water mussels, fruits, fish, insects, and worms, and will eat cultivated vegetables grown in places near its haunts. It is especially fond of apples and sometimes in its search for them finds its way into barns and cellars.

The fur of the muskrat is of great value. It is used in its natural state and is also sheared and dyed and sold as "Hudson seal" or under other names. Millions of the skins are taken each year. Scientific name of eastern muskrat, *Ondatra zibethica*, sometimes called *Fiber zibethicus*. In the northern fur country the muskrat is widely known as the "musquash."

RACCOON

SIZE: Average length, 32 inches; tail, $10\frac{1}{2}$ inches; weight, 15 to 22 pounds.

RANGE: Eastern raccoon, whole of eastern United States, west to the Rocky Mountains (except Florida), north to southern Ontario and Manitoba. Other species occur in Florida and in the wooded parts of western North America.

The raccoon has a short, heavily built body; the legs, however, are relatively long. When it walks, its hind feet are placed flat on the ground like those of a bear, but its head and face are shaped more like those of a fox. The raccoon is covered with long, thick, brownish-gray fur. Across the face is a black patch, which also surrounds the eyes, like large goggles. From the tip of its inquisitive nose is a black line extending to the forehead. These markings give the raccoon's face an anxious expression, but its beady black eyes and alert ears make it appear mischievous. The club-shaped grayish-white tail is marked with well-defined rings of dark brown or black. The front toes are long and well separated, and the front feet are used much as a monkey uses its hands.

Raccoons are expert tree-climbers. They usually make their



Courtesy, Bureau of Biological Survey

The raccoon is covered with long brownish-gray fur, with a black patch across the face, and a black line from the nose to the forehead

homes in the hollows of trees, often high above the ground. Here they build rough nests where three to six young are reared each year. They like especially to live on the wooded shores of lakes or streams. Here their tracks may often be seen in the mud, and can be easily recognized because of the impressions of the long fingers and toes. They are good swimmers and are able to catch fish that come near shore, although they cannot dive.

They have the curious habit of sometimes washing their food before eating it. They eat crayfish, clams, and other water animals; birds and their eggs; nuts, fruits, and vegetables. In the late summer and early fall they show a great fondness for green corn, which often leads them into trouble with the farmer.

The raccoon hibernates during the severest part of the winter, retiring rather early and appearing again in February or March. The hunting of raccoons is a favorite sport in the Southern States. This is done at night, as the raccoon sleeps in the daytime and goes about at night. Raccoon fur is in great demand. Sometimes "coons" are kept as pets. They are very intelligent and have a restless curiosity which makes them examine every strange object with interest. They are particularly attracted by anything bright and shiny. Sometimes they are lured into traps by means of a bright object, such as a piece of tin. Scientific name of eastern raccoon, *Procyon lotor*.

MAMMALS OF MEADOWS AND PRAIRIES

STRIPED GROUND SQUIRREL OR GOPHER

SIZE: Total length, 11 inches; tail vertebrae, $3\frac{1}{2}$ inches.

RANGE: Central North America from eastern Michigan to Montana, north to the Saskatchewan Plains, south to Utah, and on the prairies and plains to central Texas.

Because its markings blend with the brown earth and plant stems, the striped ground squirrel when quiet is not easily distinguishable from its surroundings. This helps to protect it from its enemies—the coyote, fox, badger, skunk, weasel, and the birds of prey. The striped ground squirrel, also known as the "striped gopher" (but a very different animal from the pocket gopher) is a slender little animal, scarcely a foot in length, even counting its tail. On its back are seven yellowish stripes and six rows of spots.



Photograph by E. L. Warren

Courtesy, Bureau of Biological Survey

The striped ground squirrel has yellowish longitudinal stripes alternating with rows of yellow spots, making about thirteen stripes in all

The striped ground squirrel is found in grassy prairies and old fields. Usually it selects a grassy spot or weedy growth in which to dig its rather shallow burrow. The opening to the burrow is about two inches in diameter and the tunnel goes straight down for several inches, then turns and runs almost level, with many winding branches, several of which lead up to the surface. Usually the dirt excavated in digging the burrow is scattered several feet from the opening. As in the chipmunk's home, there are separate chambers for the nest and for storage purposes.

The striped ground squirrel sleeps or hibernates all winter. In the summer it is active during most of the daytime, and its sharp call of alarm is often heard.

From five to thirteen young are born the last of May or early in June. Tiny, blind, hairless creatures, they develop very slowly and remain with the mother until toward fall, when they are nearly grown.

Although they eat grain, seeds, and nuts, ground squirrels are particularly fond of insects, and also they sometimes kill and eat mice and young birds. Ground squirrels are destructive to crops,

but plowing destroys their shallow burrows, thus keeping down their numbers. The number of harmful insects and mice which they devour usually more than compensates for the damage they do. Scientific name of striped ground squirrel, *Citellus tridecemlineatus*. In the West there are numerous other kinds of ground squirrels.



Courtesy, Bureau of Biological Survey

The eastern mole has soft, slate-colored fur and a naked pink tail

MOLE

SIZE: Total length of eastern mole, 6 to 8 inches; tail vertebrae, 1 to $1\frac{1}{2}$ inches. The Oregon mole and the star-nosed mole are somewhat larger.

RANGE: Eastern mole, eastern United States, south to Florida, westward to the Great Plains; star-nosed mole, eastern Canada and eastern United States, south to Illinois and Georgia. Other species are found north to southern Canada and west to the Pacific coast.

Although it has a queer appearance, the eastern mole is wonderfully adapted to life underground. It has a compact and powerfully built body covered with gray velvety fur, and a short, naked pink tail. Its pointed nose and its short paddle-like fore feet armed with strong claws are well fitted for digging. Its eyes and ears are very small. The eyelids are fused together and the eyes much degenerated, but probably the mole can distinguish between light and darkness to some extent. External ears are also nearly lacking, but

the animal seems to be extremely sensitive to vibrations of the ground, such as are made by a person walking above its tunnels.

The mole in proportion to its size has enormous strength. When working near the surface of the ground, the mole forces itself through the earth, making a tunnel and raising a long ridge that can be plainly seen. From the deeper tunnels or in hard ground the earth must be excavated and is pushed to the surface to form small mounds or mole hills. The nest chamber is placed about a foot below the surface of the ground and from it branch out several of the deeper tunnels. The nest is made of dry leaves and other warm materials. The eastern mole has from four to six young in the spring. It remains under ground the year round, is most active at night, and pays little attention to the changing seasons.

The mole is one of the farmer's best friends, for it feeds upon cutworms and many other insects that are injurious to crops. Earthworms are also a favorite food. However, because it disfigures lawns by its tunneling and sometimes uproots young plants it is considered a nuisance and fails to receive due credit for the good it does.

There are several species and varieties of moles in North America. The largest is the Oregon mole, whose dark thick fur is very valuable. The star-nosed mole differs from other moles in having a fringe of 22 fleshy projections around the end of its nose. Its front feet are not so greatly modified for digging as in the other moles, and it has a long tail which is much thickened in the middle during the winter. Like other moles its eyelids are fused over the eyes.

The star-nosed mole is very aquatic in habits, being found in marshy places, low-lying meadows, and grassy swamps, and it is not averse to swimming among flooded cat-tails. It is sometimes caught in muskrat traps. How a practically blind animal can swim about and presumably find its burrow again is a mystery. It comes out frequently above ground even in winter.

Scientific name of eastern mole, *Scalopus aquaticus*; of Oregon mole, *Scapanus townsendi*; of star-nosed mole, *Condylura cristata*.

MEADOW MOUSE

SIZE: Total length, $6\frac{1}{2}$ inches; tail vertebrae, nearly 2 inches.

RANGE: Eastern meadow mouse, eastern United States and westward to the Dakotas and Nebraska. Other species are widely distributed throughout most of North America.



Meadow mice usually harmonize with their surroundings in color. On the back of the eastern or Pennsylvania meadow mouse the hair is dark brown

The meadow mouse has a body about as long as that of the house mouse, but much heavier. The head is rounded, the legs and tail short. Coarse, long hair covers the body and almost conceals the short rounded ears. There are ninety-one species and subspecies of meadow mice.

Different species of meadow mice are adapted to widely different conditions. Some flourish in the North, others in the South, some in marshes, others in arid sagebrush. Their color usually harmonizes with the color of the soil and the shadows of the grasses among which they live, and this helps to conceal the little animals from their enemies. The species of dry regions are usually lighter in color than those of the more moist regions. On the back of the eastern or Pennsylvania meadow mouse the hair is dark brown.

The eastern meadow mouse prefers wet meadows, but may be found in almost any place where there is thick undisturbed grass. It is found rarely in woods or bogs or in weedy orchards. It is able to live in very wet places, for it does not hesitate to swim across small ditches or pools. You can tell where there are meadow mice by finding the smoothly worn runways about an inch in width, which lead from the burrows to the feeding grounds. These runways, which are mostly under the grass, hide the mice from hawks and other enemies and also furnish a road useful in case a quick retreat from enemies is necessary.

The nest is usually built underground, but sometimes a nest of dried grass is built in a hollow on the surface of the ground or in a

tussock of grass. Several litters of from four to eight or more young are born each year.

In the summer the food of meadow mice consists chiefly of green vegetation and unripe seeds and grains; in the fall they feed upon ripe grains; and in the winter, on roots and bulbs and the bark of trees. Sometimes they become so numerous that they ruin whole crops of alfalfa or grain. They do great damage to orchards, too, by gnawing off the bark at the base of the trunk.

They do not hibernate, but in the North live in snug winter homes under the snow, moving about freely in their numberless tunnels. These little creatures are active on cloudy days as well as at night. It is only by their constant alertness and high rate of increase that they survive and thrive as they do. Scientific name of the eastern meadow mouse, also called "field mouse" or "vole," *Microtus pennsylvanicus*.

JUMPING MOUSE

SIZE: Total length of eastern jumping mouse, 8 inches; tail vertebrae, 5 inches.

RANGE: Eastern jumping mouse, from Hudson Bay and Nova Scotia south to New Jersey and Missouri. Other forms are distributed over most of the northern parts of North America, from the coast of Labrador to Bering Sea and southward to North Carolina, Illinois, New Mexico, and California.

The jumping mouse has very long and strong hind legs, fitted for jumping, and a tail which serves as a balance or rudder during the long jumps, some of which cover a distance of seven feet or more. If by accident the tail is lost, the animal is unable to retain its balance in the air, and turns helplessly in a series of somersaults. In size, the body is a little smaller than that of a house mouse. The ears are short and the eyes, small. It is provided with cheek pouches, one on each side of the mouth, in which it gathers food to be carried to its home. The color of the jumping mouse is a dull yellowish buff, similar to the color of dried grass.

The eastern form is found most abundantly in the grassy meadows and fields, especially near thickets of weeds or brush, and much less commonly in forests. In the prairie regions, these mice occur mostly in meadows, thickets, and woods along streams. However, other species in the North and West show somewhat greater preference for the forests.



Courtesy, Bureau of Biological Survey

The body of the jumping mouse is a little smaller than that of the house mouse. It is a dull yellowish-buff, similar to the color of dried grass

The summer homes are in shallow burrows, or sometimes in a hollow tree or under a piece of bark or other shelter aboveground. The winter homes are in burrows two or three feet deep, the nest of fine grass and other soft material being placed in an oval chamber. Other chambers serve as storerooms for berries, nuts—beechnuts being a favorite—and other kinds of food. The young, two to eight in number, are usually born in May or June. A second litter is sometimes raised.

This mouse has the habit of hibernating during the cold weather of winter. In late fall it becomes extremely fat, and as soon as the nights become frosty it retires to its winter home. Here it curls up in a ball with its tail wound round its body and goes into its winter sleep. At this time the mouse is cold to the touch; it is stiff and apparently lifeless, but if carried into a warm room, it slowly awakens, the rate of breathing, which during hibernation is very slow, increases, and its temperature rises to normal. In the spring, or sometimes during thaws in the winter, the hibernating mouse comes out and resumes its normal activity. It is probably at these times, when food is scarce outside, that the stores of winter food in the chambers are used. Scientific name of the eastern jumping mouse, *Zapus hudsonius*.

POCKET GOPHER

SIZE: Total length, 11 inches; tail vertebrae, $3\frac{1}{5}$ inches.

RANGE: Mississippi Valley pocket gopher, Upper Mississippi Valley south of the Canadian boundary, from southeastern Missouri and southern Illinois north to Lake Michigan, westward to the Dakotas and Nebraska, southward to eastern Kansas. Many other species occur in Florida and Georgia and throughout the West.

This ratlike animal spends almost its whole time underground in little tunnels, which wind about in all directions. It ventures out only rarely. It is well built for its life of digging and clawing little burrows through the earth. Its head and the front part of its body are very strong. The front teeth are broad and rather long and are used to cut roots, or sometimes to loosen hard soil through which a burrow is being dug. On the front feet are long claws useful in digging or handling earth. When not in use, these claws can be doubled under against the soles of the feet. The eyes are small, and the gopher has very poor sight, as is usual with animals living underground. The ears scarcely show above the fur. The tail is short and naked and has nerves by which the gopher feels its way when it goes backward.



From drawing by Ernest Thompson Seton

Courtesy, Bureau of Biological Survey

The color of the pocket gopher varies somewhat, but is usually reddish-brown on the back and sides and grayish underneath. The chin, throat, feet, and tail are nearly white

In the skin of each cheek is a large fur-lined pouch or pocket. In these pockets quantities of food are carried, to be hidden away in the underground storehouses. The pockets are not used for carrying earth, as some believe. After a quantity of ground has been loosened by the powerful front claws, the gopher turns around and pushes it out of the burrow with its broad head and strong front feet, usually managing to keep hidden behind the pile. The presence of pocket gophers is always indicated by the numerous mounds of earth formed in this manner.

The color, which varies somewhat, is usually reddish-brown on the back and sides and grayish underneath. The chin, throat, feet, and tail are nearly white.

The working tunnels of the gopher are often only about six inches below the surface, while the storehouses and nests are sometimes two or three feet below. The food consists mainly of roots. Gophers do great damage to potato crops, fruit trees, and grain and alfalfa fields by tunneling under the plants and eating the roots. The farmer considers the pocket gopher one of his worst pests. On the other hand, this little animal does a certain amount of good. Its continual working of the soil, together with the burial of much vegetable refuse, is beneficial to plant growth, while a certain amount of moisture which would otherwise run off the slopes is retained in the numerous burrows and tunnels which the gopher digs.

The pocket gopher does not hibernate. It is active throughout the winter, even in the coldest part of its range. In many places, however, it must rely largely on food stored in the chambers of its burrow. It works both day and night. It does not like the light, and if a tunnel is opened, by chance, the gopher closes the opening as fast as it can. It fights readily, too, for it has many enemies. Snakes and weasels, badgers, foxes, coyotes, hawks, and owls are ever on the watch for it. If one gopher enters the tunnel of another, the owner of the tunnel at once attacks the intruder.

One litter of from two to six young is born each year. When the young are about half grown, they make little tunnels of their own, one or two hundred yards from their parents' tunnels.

In Florida and Georgia the pocket gopher is called "salamander" which is really the name of an amphibian, while the name "gopher" is there applied to a land tortoise. Scientific name of Mississippi Valley pocket gopher, *Geomys bursarius*.

MAMMALS LIVING ON ARID PLAINS

PRAIRIE DOG

SIZE: Total length, about 15 inches; tail vertebrae, about $3\frac{1}{2}$ inches.

RANGE: Over the Great Plains, west to Utah and Arizona, extending from Montana and North Dakota, south to Texas and Mexico.

The prairie dog is not a "dog" at all, but a rodent or gnawing animal. Its bark, which is short and sharp, somewhat like a puppy's, is its only resemblance to a dog. It is a stout little animal with strong legs and claws for digging. It has a rounded head, small eyes and ears, short neck, and short tail. It is reddish- or grayish-brown on back and sides and a lighter color underneath.

It likes sunshine and a dry atmosphere. These conditions it finds in the semi-arid parts of the Great Plains. It is active during the day rather than at night. Prairie dogs are sociable animals and build colonies or "towns" with the number of animals living in them varying from a few to sometimes millions. The towns sometimes spread over hundreds of square miles. The burrow is located on flat or gently sloping ground. It goes down at first from eight to sixteen feet at a steep slope, then it branches off straight or slightly upward in several directions. Some of these branching tun-



Photograph at right, courtesy, Bureau of Biological Survey

The prairie dog is reddish- or grayish-brown on its back and sides and a lighter color underneath

nels lead to "rooms" slightly elevated. These rooms are used for refuse, for stores of food, for "living" rooms, and for nests in which the four to six young are born in March, April, or May.

The little mound of earth around the entrance of the burrow is packed down hard. It is shaped by the feet and pressed down by the nose. It prevents water from flooding into the burrows during rainstorms. It also serves as a point from which the little animal can look around to see that no danger is near before it scampers about in its search for food or to greet its neighbor. At the approach of man an alarm note is sounded at which those away from their burrows rush to the entrance mounds, where they sit or stand erect, twitching their tails and barking excitedly, or disappear into their burrow.

In the northern part of their range or in the snow-covered mountains, prairie dogs hibernate during severely cold weather. Farther south they are out of their burrows every day in the winter except on very stormy days. They eat grass and other plants, seeds, and sometimes insects. They are very destructive to grain and alfalfa crops and are considered a pest by farmers. Ordinarily the green plants, which form the greater part of their food, contain enough water so that they do not need to drink. During periods of drought, when the vegetation may be entirely dry, some water is obtained through the digestion of the starches and other food materials found in the grasses they eat.

Scientific name of the prairie dog of the northern Great Plains, *Cynomys ludovicianus*.

PRAIRIE COYOTE

SIZE: Total length, about 48 inches; tail vertebrae, 11 to 14 inches.

RANGE: Northern Mississippi Valley and north edge of plains, westward to the base of the Rocky Mountains in the Province of Alberta.

The coyote belongs to a group of small wolves that have their home in western North America. It is an animal of the open plains and prairies, but lives also in brush or open woods and is sometimes called "brush wolf." It is about two-thirds the size of the gray wolf and has a rather foxlike head with a long pointed nose. It has a shaggy coat of light yellowish- or reddish-gray and a tail somewhat more bushy than that of the gray wolf.



Courtesy, Bureau of Biological Survey

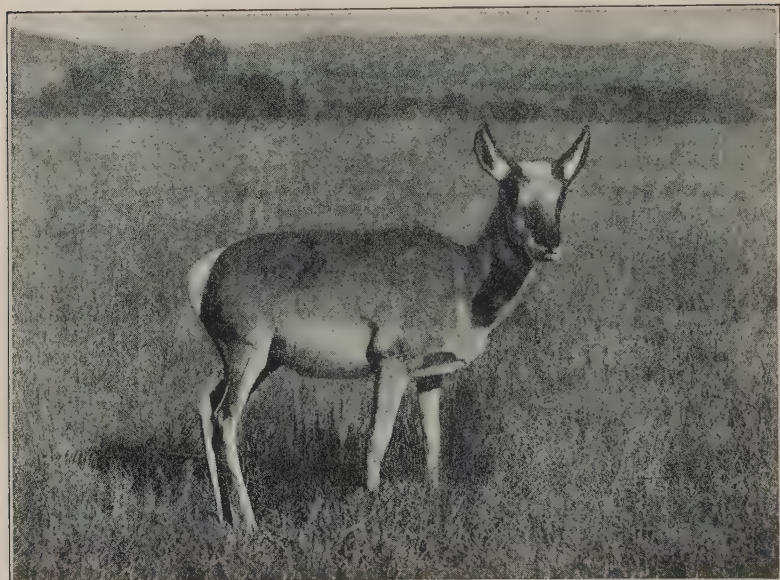
The coyote has a shaggy coat of light yellowish- or reddish-gray

The coyote is sometimes called "barking wolf," on account of its cry, which is very different from that of other wolves. The call begins with a series of sharp yelps which run into a high-pitched wailing howl. Sometimes it sounds as though a whole pack of coyotes were yelping and howling, when in reality there are only one or two.

Like the dog, the coyote will sometimes bury food, if it has secured more than it can eat at one meal. Part of its food supply in winter consists of sheep and cattle that have perished of the cold. The coyote is not entirely a flesh-eater, and in some localities it has developed a taste for fruit.

Coyotes are very destructive to poultry and sheep. For this reason efforts have long been made to exterminate them. But they are very cunning in escaping traps, poison, and guns. They are swift runners and know how to capture animals fleetlier than themselves. Sometimes two coyotes will take turns in running down a jack rabbit.

For its home the coyote may choose a natural hollow or it may dig a burrow in the earth or make its den among loose rocks. Often it will enlarge a prairie-dog's or badger's burrow. In the spring from three to ten pups are born. The young animals are readily reared but seldom become very tame. Scientific name of prairie coyote, *Canis latrans*. In the West are numerous other species.



Photograph by J. C. Dort

Courtesy, U. S. Forest Service

The pronghorn antelope is a bright yellowish-brown above, and has white markings on its chin and cheeks. The underpart of the body and a broad patch around the tail are also white

PRONGHORN ANTELOPE

SIZE: Male, length, 48 inches; tail, 7 inches; height at shoulder, 36 inches; horns about 12 inches in length; weight, 120 pounds. Female, smaller.

RANGE: Formerly throughout plains country from 53 degrees latitude south to Mexico, and from the valley of the Missouri to the Pacific. Now, the range is restricted principally to a strip extending along Rocky Mountain area.

A slender fleet-footed animal, the American or pronghorn antelope is distinctly an animal of the open country. It does not, like the deer, try to hide from its enemies, but rather attempts to see them first and then elude them. It holds its head erect and with its bright eyes scans the distance for the first sign of danger.

The pronghorn is somewhat smaller than the Virginia deer. The color is a bright yellowish-brown above, darker on the face, with white markings on chin and cheeks. The underpart of the body is

white and there is a broad white patch around the tail. When the antelope is alarmed or excited the white hairs of the tail patch are raised on end, forming two very conspicuous chrysanthemum-like rosettes that serve as a signal. The horns, which give the animal its name, are curved inward and have a short prong or hook at the end. These horns are shed each year, as are those of the deer, but there remains a permanent bony core over which the new horn develops.

Though now found only in a few scattered places, the pronghorn antelope was once almost as numerous as the buffalo on the Great Plains of America. Late in the fall it formed great herds made up of tens of thousands. The herds remained together during the winter and separated into smaller parties in the summer.

The young, usually two, are born in May or early June. They are not spotted, but are colored like the mother. For the first few days they remain motionless on the ground but are soon able to run well and go about with the doe. Scientific name of pronghorn antelope, *Antilocapra americana*.

BUFFALO OR BISON

SIZE: Male, length, 10 to 11 feet; height at shoulder, 5 to 6 feet; length of tail, 15 inches. Female, height at shoulder, $4\frac{1}{2}$ to 5 feet.

RANGE: Formerly from the Atlantic coast to the Rocky Mountains, and from northern Mexico to 60 degrees latitude; now only on reservations, except for the wood bison near Great Slave Lake in Canada.

This great heavy animal belongs to the same family as our domestic cattle, though it looks very different from them. The massive head and high arched shoulders are probably the first things noticed about the buffalo, or bison, as it is more properly called. Heads and shoulders are covered with dark brown shaggy hair. The hair on the body and hind quarters is short and is light brown or grayish in color. The tail is rather short and ends in a tassel of hair. The head is carried low and from the neck hangs a great beard that falls almost to the ground. The short sharp horns grow wide apart. They are not shed each year as are the antlers of the deer, but remain through life. The full grown male of the American bison weighs about 2,000 pounds. The female is somewhat smaller.

With the approach of spring the bison begins to shed its winter



Courtesy, Department of Trade and Commerce, Ottawa, Canada

A herd of buffaloes on a wild life reserve in Canada

coat of shaggy hair and all through the summer it has a very ragged appearance. In the fall the hair grows again and is thickest in November and December.

The calves are born about May or June. Usually there is only one, but sometimes there are twins. Before they are a week old they are strong enough to run with the herd.

Buffaloes feed chiefly upon grasses. Great herds once roamed over the plains of North America, moving about from one grazing place to another. Many of the highways of today follow trails first tramped by the hoofs of bison. It was hunted both for its fur and for its flesh. So wastefully were the bison slaughtered that, although there had been millions, they were almost exterminated. There are still herds in northern Canada, in Yellowstone National Park, and in Montana, where they are carefully protected. Scientific name of American bison or buffalo, *Bison bison*.

BADGER

SIZE: Length, 19 to 20 inches; tail vertebrae, 5 inches.

RANGE: Originally from northern Alberta and Michigan south to Mexico and west to the Pacific coast. Now extinct over large areas.

No other mammal, except the mole, is so rapid a burrower as the badger. With its strong claws and powerful muscles, the badger

is well adapted for digging rapidly, even in quite hard soil. It uses both fore and hind feet in its work, the fore feet for tearing away the earth, the hind feet for throwing it out of the hole.

The color of the badger is grizzled gray above and yellowish-white below. It has a prominent white stripe down its face, extending from the tip of its nose over the forehead to between the shoulders. Its legs are short and its broad heavy body is carried low to the ground. Its tail is short. The outer hair is long and coarse and is underlaid by a thick fur.

The home of the badger is on the open plains and prairies, where its large burrows, six to eight inches in diameter, are commonly found. It is also found in brush lands and in open forests.

Little is known of the family life of the badger, but it is known to have one litter of three to five young early in spring. It is active mainly at night, but is occasionally seen abroad during the day. Early in June one year, in southeastern Washington, the writer saw a badger family—presumably a mother and three half-grown young—returning early in the morning from the night's hunting expedition. In the North, the badger becomes very fat in the fall and hibernates during the winter, but in the South it remains active all the year.

When attacked, a badger will defend itself to the last with its



Courtesy, Bureau of Biological Survey

The badger is a grizzled gray color above and a yellowish-white below. A conspicuous white stripe runs down its face, from nose to shoulders

sharp teeth and powerful jaws. No animal of its own size can overcome it. In olden days, badger-baiting with a pack of hounds was a popular sport. This practice is now happily a thing of the past. In captivity, however, the badger when not molested is usually quite good-natured.

Its food consists of mice, pocket gophers, ground squirrels, and other burrowing or ground-living animals. In digging these animals out of their burrows, the badger spends a large part of its time. As a destroyer of these injurious rodents, it is a good friend of the farmer. In spite of this, however, it is usually killed when found, because its large burrows are unsightly and sometimes dangerous to domestic cattle and to horsemen.

The badger is related to the mink and otter and has similar strong smelling scent glands. Scientific name of the American badger, *Taxidea taxus*.

BLACK-FOOTED FERRET

SIZE: Total length of male, 23 inches; tail vertebrae, $5\frac{1}{2}$ inches. The female is a little smaller.

RANGE: Arid Great Plains from Montana and North Dakota south to western Texas, west to the Rocky Mountains.



Courtesy, Bureau of Biological Survey

The black-footed ferret is a pale yellowish-tan color, with a black mask across the face, black feet, and a black-tipped tail

The black-footed ferret has the same bold and inquisitive traits as the weasel, though it is much larger in size. It is as large as a mink, but is more slender and its legs and tail are longer, fitting it for a life on the plains. Its general color is very pale yellowish-tan, which harmonizes with dried grass or bare soil. Across the face is a broad black mask; the feet and lower legs and the end of the tail are also black.

This ferret is nearly restricted to the Great Plains, where it is usually found in prairie-dog towns. Here it lives in a deserted burrow and feeds on prairie dogs, both young and old. As the ferret can enter the burrows the prairie dog has no means of escape. By destroying these harmful rodents the ferret performs a valuable service. It probably also destroys rabbits, ground squirrels, and other rodents, as well as some ground birds. Unfortunately, owing to its fearlessness, the black-footed ferret is easily killed by man, and it is now becoming very rare. Scientific name of black-footed ferret, *Mustela nigripes*.

NINE-BANDED ARMADILLO

SIZE: Total length, 32 inches; tail, 15 inches.

RANGE: Southern Texas south to Argentina.

The armadillo is notable among North American mammals by having the back and sides of the body and the upper part of the head covered with a coat of armor formed of bony plates. The shield covering the body has eight movable rings in the back and nine on the sides. The back is black and the sides yellowish-white. On the undersurface of the body is a sparse growth of yellowish hairs. In South America numerous kinds of armadillos occur, and the nine-banded armadillo found in Texas is the most northern member of the group.

The armor of the armadillo is probably of protective value against predacious birds and the smaller carnivorous mammals, but a coyote can bite through the protective plates and kill the animal. It has been suggested that the armor may also protect the animal from the numerous thorny shrubs found in its habitat.

The armadillo is a stupid animal and it has weak eyesight and poor hearing, but its sense of smell is good. Its armor handicaps its movements and it runs awkwardly. On open ground it can be run down by a man on foot. It resembles a small pig somewhat in appearance and movements. Like the pig also it enjoys mud baths.



Courtesy, The New York Zoological Society

The back of the armadillo's shield is black; the sides, yellowish-white

The armadillo lives in forest, in brushy thickets, or in tall grass. The home is a rocky cave or a burrow excavated by itself. Here, between February and April, are born litters of usually four, but sometimes eight, young. All four of the young are of the same sex, being identical quadruplets. At birth their armor is soft, but it hardens as they mature.

The food of the armadillo consists of insects, spiders, centipedes, and earthworms. These are licked up by the long sticky tongue, which is somewhat like that of the anteater, a near relative. Many of the insects eaten are agricultural pests and the armadillo is a wholly beneficial species which should be everywhere protected. Nevertheless, many are killed to make souvenir baskets, or just for sport. Scientific name of Texas nine-banded armadillo, *Dasypus novemcinctus texanus*.

KANGAROO RAT

SIZE: Banner-tailed kangaroo rat, total length, 13 inches; tail vertebrae, $7\frac{1}{2}$ inches.

RANGE: Banner-tailed kangaroo rat, from southeastern Arizona east to western Texas, south into Mexico. Other species are found over the arid and semiarid parts of the western United States from Montana and Washington south to Mexico and east to Nebraska and Oklahoma.

The kangaroo rat resembles the kangaroo in having very large hind legs fitted for jumping. Like a kangaroo also it carries itself usually in a semi-upright position, supported mostly or entirely on its hind limbs. The size of the animal is about that of a small rat. The tail is very long and has a tuft of hair on the tip. Probably the tail serves as a rudder in the air during the long jumps which the animal makes when fleeing from enemies. The color of the back varies in different species from brownish-buff to pale yellowish-buff, thus resembling in some degree the color of the desert soils where the animal lives. The underparts are white, and across each hip is a prominent white stripe. On the sides of the head are a pair of cheek pouches which open near the mouth.

The front feet of the kangaroo rat are small and rather weak, and although the animal digs burrows for its home, it is not able to dig in very hard soil. For this reason it is mostly restricted to sandy soils, where the burrows can be dug easily.

The banner-tailed kangaroo rat piles up large mounds of earth, which it honeycombs with its tunnels. A large chamber contains the nest of soft, dry grasses, and there are also storage chambers for food. The animal is active only at night and during the daylight



Photograph by Elwin R. Sanborn

Courtesy, The New York Zoological Society

The back of the kangaroo rat varies in different species from brownish-buff to pale yellowish-buff. The underparts are white, and across each hip is a conspicuous white stripe

hours the outside entrances to the tunnels are plugged with earth from within.

The food of the kangaroo rat consists principally of the seeds of grasses and other plants and of small wild fruits. Heads of ripe grass or other food material are cut off by the large front teeth, stuffed by the front feet into the cheek pouches, and carried to the den to be devoured at leisure or placed in a storage chamber. Over twelve pounds of stored food have been found in a single mound of the banner-tailed kangaroo rat, presumably all collected by a single individual, for these animals live singly except during the mating season. As it does not hibernate it must live entirely on this stored food during the seasons of food scarcity which occur in desert and arid regions.

Probably the kangaroo rat never drinks any water. Very little water is present during most of the year in its natural habitat, and individuals kept in cages never drink even when fed entirely on dry grains. When by accident one gets its nose wet it acts as if displeased. When succulent vegetation is available the kangaroo rat will eat such things as cactus stems and thereby secure some water, but when necessary it can exist for long periods without other water than that obtained from the digestion of dry grains and seeds.

One or two young are born some time between January and August. Whether there is more than one litter per year is not known.

The food of the kangaroo rat is mostly of little economic value and only rarely are crops or range grasses seriously injured. On account of its interesting habits it should not be destroyed, except where it is actually causing damage. Scientific name of the banner-tailed kangaroo rat, *Dipodomys spectabilis*.

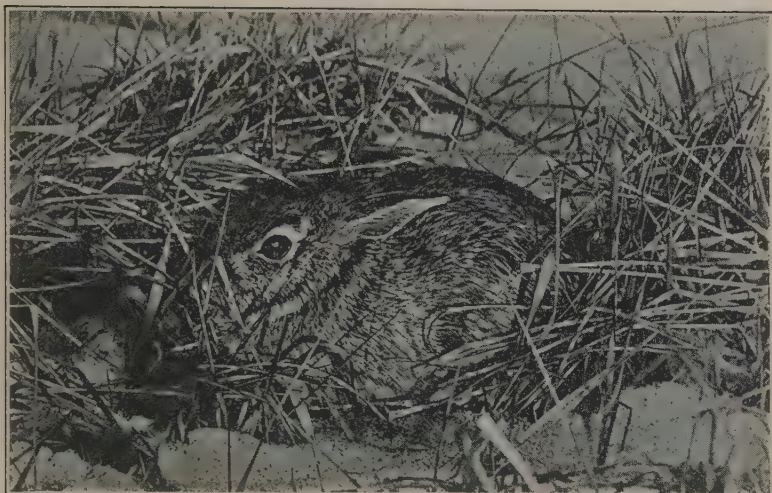
MAMMALS PREFERRING BRUSHY PLACES

COTTONTAIL RABBIT

SIZE: Eastern cottontail, total length, 18 inches; tail vertebrae, 2 inches.

RANGE: Cottontails of several species occur over the United States east of the Cascade Mountains, from nearly the northern border of the United States south to Mexico.

The cottontail rabbit is a queer mixture of timidity and bravado, well portrayed in the "Uncle Remus" tales of "Brer Rabbit." Al-



Courtesy, Bureau of Biological Survey

The cottontail rabbit has a grayish-brown back and a short white tail

though it may squat motionless or scurry away at the first hint of danger, yet the cottontail flourishes wherever brushy cover is present, living frequently on city lawns, in spite of the presence of numerous dogs and other enemies.

To warn it of approaching danger the cottontail has very large ears. Its large eyes enable it to see well in weak light, for it is active mainly early in the morning and late in the evening. Its hind legs are long and strong and it can make great speed for a short distance in running, though it does not have the endurance of its cousin, the jack rabbit. When traveling slowly its long hind legs prevent its walking in the manner of a cat and it progresses by little hops. When sitting quietly among dead leaves and dry grasses the grayish-brown color of its back tends to conceal the animal. As it dashes away its short white tail flashes up and probably serves as a signal to others of its kind.

The cottontail is often found sitting in a shallow depression or form made in some patch of brush or near the base of a tree. At times, especially in very cold weather, it will live in the abandoned burrow of the woodchuck or of some larger animal. Also, when hard pressed by dogs or other enemies, it will often take refuge in any burrow at hand or even climb up inside a hollow tree. The

young, four to six in number, are born in a nest placed just below the surface of the ground, often on a lawn or in some other open place. The nest is made of a small amount of dried grasses, and it is lined with soft warm hair pulled by the mother from her own breast. The first litter of young are born in late April or early May. Other litters appear later in the summer. At birth the young have only a scanty amount of hair on the body and the eyes are closed.

For food almost any kind of fresh grass or other green vegetation will serve the cottontail, and often gardens or field crops are damaged. In winter it eats the smaller twigs of willows and of other shrubs and trees. It will sometimes gnaw the bark from fruit trees and create havoc in the nursery or orchard.

The mink, weasel, coyote, wolf, hawk, owl, and a host of other carnivorous animals, including man, prey upon the rabbit, but by means of its rapid rate of reproduction and its keenness in eluding pursuit, it is able to thrive in most parts of the country. Scientific name of the eastern cottontail rabbit, *Sylvilagus floridanus*.

CHIPMUNK

SIZE: Total length, 9 to 10 inches; tail vertebrae, 3 to 4 inches.

RANGE: Eastern chipmunk, in the eastern United States and eastern Canada west to the Great Plains. Various species range over the greater part of North America.

This sprightly little animal, with its cheerful "Chip, chip, chip"—from which it gets its name—in some ways resembles its cousins, the tree squirrels. Like them it is attractive and friendly, and it is easily tamed. The chipmunk has reddish-brown or gray fur marked with black and white stripes. It has roomy cheek pouches in which it carries food to be stored away for winter use. These pouches open inside the mouth.

The chipmunk furnishes an excellent example of how animals prepare for the winter. It collects an astonishing quantity of nuts, acorns, and seeds. Frequently these are stored temporarily under logs and in shallow holes and roots and trees and are later removed to the burrow.

The chipmunk's home is hard to find, for it is not marked by conspicuous mounds of earth as in the case of most burrowing animals. The opening, which is smaller than the rest of the tunnel, is generally pretty well concealed by the grass around it. Usually there is a series of tunnels some yards in length, with a nest and



Photograph by C. Birdseye

Courtesy, Bureau of Biological Survey

The fur of the chipmunk is a reddish-brown or gray color, and is marked with black and white stripes

storage chamber two or three feet underground. In the nest, which is filled with dry leaves and grass, the chipmunk hibernates, though its sleep is not very profound, and the length of time it remains in the nest depends upon the severity of the winter. In the summer, rocky ledges covered with vines and brush and old fences and stone walls in dry sunny places near the woodlands are its favorite haunts. The young, of which there are four or five, are tiny, blind, naked, helpless little creatures.

The chipmunk has many enemies. It must be ever on the alert to guard against cats, martens, foxes, snakes, and birds of prey. Its worst enemy is the weasel, which often follows it into its burrow.

In addition to nuts, berries, and seeds, the chipmunk eats insects, snails, small snakes, and young birds and eggs. It sometimes annoys the farmer by digging up newly planted corn. Scientific name of eastern chipmunk, *Tamias striatus*.

STRIPED SKUNK

SIZE: Total length, 24 inches; tail, 8 inches; weight, 7 to 8 pounds.

RANGE: Over nearly all of North America south of Hudson Bay.

The skunk is one of the most unpopular animals because of its bad odor. This odor is produced from the secretion of two glands situated near the base of the tail. The skunk seems to know what a



Photograph by A. J. Olmstead

Courtesy, Bureau of Biological Survey

The striped skunk has long, rich fur with two white stripes down the back and one on the face from the tip of the nose to the brow

good protection these glands are, for usually it moves along very slowly and without fear. It makes a pretty picture, too, with its beautiful plumelike tail slightly lifted; but we must not venture too near. The fluid which it secretes can be thrown a distance as great as ten feet and sometimes even greater. It is not only offensive and stifling but irritating as well, especially to the eyes, but it does not produce blindness as popularly supposed.

The striped skunk is about the size of a cat, though of a heavier build. Its fore legs are short, with heavy claws for digging; its hind legs are longer. This gives the skunk a rather awkward appearance in walking. It has long rich fur with two white stripes extending

down the back from a white patch on the neck. The face has a white stripe extending from the tip of the nose to the brow. The muzzle is long and pointed, the tail long and bushy. It is found in all kinds of country, usually in brush patches. It also seems to like to live near the home of man and is often found beneath outbuildings. The skunk does most of its hunting for food by night, although it is occasionally seen abroad in the daytime.

In the fall it becomes very fat, and during the severest part of the winter it hibernates, or lies in a deep sleep. During a thaw, or at times when the weather becomes mild for a short period, its sleep may be broken for a few days and it ventures forth from its burrow.

The skunk usually lives in a burrow, which it may dig for itself, or which may have been abandoned by some other animal. Sometimes it makes its den in a decayed log, in a stump, or in crevices among rocks. The nest is built of grass or leaves at the end of the den and here a single litter of young, containing from four to ten, is born in April or May.

The common skunk feeds upon insects and small rodents, reptiles, ground-nesting birds' eggs, and numerous small fruits. Sometimes it robs a chicken yard, but the good it does the farmer by destroying harmful insects, field mice, and other pests more than offsets this bad habit.

The fur is valuable. Dyed and sold as Alaska sable or under other names, it is in great demand.

Scientific name of striped skunk of eastern United States, *Mephitis nigræ*. In the southern and most of the western parts of the United States are found the little spotted skunks, belonging to another group. In Texas, extending to Colorado, are found the white-backed skunks, forming still another group.

MAMMALS OF THE EASTERN HARDWOOD FORESTS

FOX SQUIRREL

SIZE: Total length, 21 to 26 inches; tail vertebrae, 10 to 12 inches.

RANGE: Virginia to Florida, west to southern Wisconsin, eastern Kansas, and Texas.



The color of the fox squirrel varies in different regions from a rusty color to dark gray and black

The largest of the North American squirrels is the fox squirrel. More heavily proportioned than the other squirrels, it does not move so quickly or gracefully, but it is a very handsome animal. Its color varies in different regions. In the Ohio and Upper Mississippi valleys it is a rusty color. In the southeastern United States it is dark gray and black, with white ears and nose. Its habits are much the same as those of the gray squirrel, except that it prefers more open woods. Scientific name of fox squirrel or black fox squirrel, *Sciurus niger*; several subspecies are recognized.

FLYING SQUIRREL

SIZE: Total length, about 9 inches; tail vertebrae, 4 inches.

RANGE: From the limit of trees in Alaska and Canada south in the eastern United States to the Gulf of Mexico, and in the forests of the West, south to Utah and California.

The flying squirrel cannot really fly, as do the bats, but it is able to glide through the air for long distances. A thin fold of skin, covered on both sides by fur, extends between the front and hind leg on each side. When the animal extends this by stretching out the legs, a broad sailing surface is exposed. The hairs of the tail are long and extend out on each side, adding, therefore, to the supporting surface. The squirrel climbs to the top of a tree and, jumping off into the air, glides downward to the trunk of another distant

tree; this tree it must climb before it is able to repeat the glide.

The color of the flying squirrel is brownish-gray above and white beneath. Its fur is very long and soft. The eyes are larger than those of other squirrels, adapting the animal to see in dull light, for contrary to the habits of other squirrels it is active at night.

Flying squirrels are quite common throughout North America as far south as the Mexican border, but, since they are nocturnal in their habits, they are not so well known as the other squirrels. During the day they lie in their nests curled up like little balls of fur. About sunset they become active and play more or less continuously through the night.

The flying squirrel makes its home in the hollows of trees or in



Courtesy, American Museum of Natural History

The flying squirrel is a brownish-gray color above and white beneath. Its fur is very long and soft

woodpecker holes. It has also been known to take up its residence in bird houses and in attics, cupboards, and other nooks and corners in occupied or unoccupied houses. Sometimes, like other squirrels, it builds in the trees nests of leaves lined with fibrous material, grass, moss, and fur. Sometimes it remodels other squirrel or bird nests for its own use. From two to six young are born in the spring and are tenderly cared for by the mother.

The flying squirrel does not hibernate, so far as we know. It eats not only all sorts of nuts and many kinds of seeds and grains but also fruits and insects, and it is very fond of eggs and young birds. This little animal is easily tamed and makes an interesting pet, but it is mischievous and is likely to do damage to furniture and hangings. Scientific name of flying squirrel of eastern United States, *Glaucomys volans*.

GRAY SQUIRREL

SIZE: Total length of eastern gray squirrel, 18 to 20 inches; tail vertebrae, 8 to 9 inches.

RANGE: Eastern gray squirrel, eastern North America from Nova Scotia to Florida and west to the Great Plains.

In the fall the gray squirrels may be seen scampering about, their cheek pouches puffed out with nuts or seeds that they are carrying to store away for the winter in holes in trees or in hiding places in the ground. They do not spend all of the winter in their nests, however, and do not depend entirely upon their store of nuts. Except in the most severe weather they may be found scurrying about for more food.

The squirrel is well built for climbing, having an agile body and sharp claws. Its fore paws can be used like hands for grasping and its sharp teeth are well adapted for cutting through the hard shells of nuts. The fur of



The fur of the gray squirrel often has a brownish or rusty tinge

the gray squirrel often has a brownish or rusty tinge, and frequently individuals are found that are almost black.

The squirrels live either in the hollows of trees or in nests in the tree tops that they build of small sticks and leaves, lined with bits of bark, moss, and other soft material. There are two litters a year of from four to six young. The mother guards the little squirrels very carefully, and if the nest is disturbed she will carry them to a safer place.

Squirrels eat all kinds of nuts and also eat seeds, berries, and mushrooms. When they live near fields or orchards they take corn and wheat, and also steal apples, pears, and other fruit for their seeds. They are also fond of insects, and they sometimes destroy birds' eggs and small birds. In this last habit the gray squirrel is not so bad as the red squirrel, however. Scientific name of eastern gray squirrel, *Sciurus carolinensis*. Along the Pacific coast and in the Southwest occur other species gray in color, but not closely related, and having somewhat different habits.

WHITE-FOOTED MOUSE

SIZE: Eastern white-footed mouse, total length, 7 inches; tail vertebrae, 3 inches.

RANGE: Eastern white-footed mouse, Nova Scotia and eastern United States, south to North Carolina, Louisiana, and Mexico, west to eastern Montana and Arizona.

The most abundant mammal of temperate North America is the white-footed mouse or deer mouse, of which there are many species and races, distributed from Mexico to far north in Canada. The eastern white-footed mouse lives chiefly in the hardwood forests and in adjacent thickets. It follows the timber and thickets along the streams far out into the plains. The prairie deer mouse, on the other hand, lives in the grassy prairies, open fields, and on lake beaches, sometimes invading open thickets and the edges of woods. Of the other related forms of these mice, some live in conifer forests, some in rocky canyons, others in hot deserts. It is interesting that the forms living in damp forests tend to be dark in color, while those of the desert are usually pale. On an island formed of white sand in Florida the deer mice are almost completely white.

This mouse is slightly larger than the house mouse, but is a much more attractive creature. Its fur is soft and beautiful and varies



Photograph by Frank Morley Woodruff

A family of white-footed mice in their nest built in an old log

in color from a pale buff to a dark brownish gray. The underparts and feet are white. Its ears and eyes are much larger than those of the house mouse. Although shy, these mice can be easily tamed and make very attractive pets.

The home of the white-footed mouse is usually a burrow in the ground or under a rock. In one of the chambers of the burrow is built a nest of dried grass and other soft materials. In the woods the nest may be placed under a stump or log, or sometimes in the branches of a tree or shrub; a deserted bird's nest is sometimes made over into a home. Two or more litters of three to seven young are born each year. At birth the babies are pink, naked, and blind, but they develop quickly and at six weeks of age they are practically fully grown mice.

The white-footed mouse is very nimble and active and seems quite as much at home in the trees as on the ground. It is active mainly at night, sleeping during the day in its nest. Its food consists of fruits, seeds, succulent plants, and insects. At times it invades houses, especially miners', trappers', and hunters' cabins, and occasionally it becomes somewhat of a pest by carrying off supplies of food. It is active all winter and its tracks may often be seen on the snow, but in the fall it gathers large stores of seeds, beechnuts, and other food to use during stormy weather.

As is true of all small mammals the deer mouse has many enemies. Hawks, owls, weasels, skunks, foxes, and other predacious forms prey constantly upon it, and it is only by its rapid rate of increase that it is able to survive. Scientific name of the eastern white-footed mouse, *Peromyscus leucopus*; of the prairie deer mouse, *Peromyscus maniculatus bairdii*.

SHREW

SIZE: Total length of masked shrew, 4 inches; tail vertebrae, $1\frac{1}{2}$ inches. Total length of short-tailed shrew, 5 inches; tail vertebrae, 1 inch.

RANGE: The long-tailed shrews are found in northern North America from southeastern Canada and Alaska south to North Carolina, New Mexico, and California. The short-tailed shrew is found from western Nebraska and Manitoba eastward to the Atlantic coast and south to the Gulf of Mexico and Mexico. Numerous species of both forms occur.

The masked shrew of the eastern United States is one of the smallest mammals. It is only about four inches long and nearly half of its length is made up by the tail. A fully grown individual weighs only one-quarter of an ounce. The masked shrew is covered by thick soft fur of a grayish-brown color. The summer coat is browner than the winter one, which is more of an ashy gray or lead color. In shape the shrew somewhat resembles a mole, to which it is closely related, but the feet are not enlarged for digging. The snout is long and pointed and very flexible, and probably has a highly developed tactile sense as well as a keen sense of smell. The eyes are very small, and although not covered over completely by the eyelids, as in the moles, they are probably not of much service for seeing. The rim of its ears show just a little above the velvety fur, but its hearing seems to be exceedingly acute.

This tiny animal lives amid the vegetation or débris on the surface of the ground of the forest or in little burrows below. It uses the runways already made by field mice and other small animals and also makes runs of its own when necessary. Its nest is a small ball of dry leaves or grasses placed in a burrow, under a log, or in a hollow stump. One or more litters of from six to ten young are born during the spring and summer.

The short-tailed shrew, sometimes called mole shrew, is darker



Courtesy, American Museum of Natural History

The shrew is closely related to the mole, which it resembles in shape colored, larger, more heavily proportioned, and has a shorter tail than the long-tailed shrew. Its habits are much the same.

The shrew feeds chiefly upon insects and worms and thus is an aid to the farmer. It also eats mice, which it can kill itself. Sometimes, when its natural food supply runs low, it will go into store-houses and dwellings and eat meat, fat, flour, seeds, and nuts. The little shrew digests its food so rapidly that it is almost always hungry, and it works constantly with a very hurried air to keep its appetite satisfied. It is active not only during the night, but also during the day.

So far as we know the shrews do not hibernate during winter, but are active at all seasons, even in temperatures much below zero. However, much of their time is spent in little tunnels under the leaves and they do not often come out on the surface of the ground. They often push their little tunnels through the snow, just at the surface of the ground. The short-tailed shrew has been known to store living snails, beetles, and beechnuts, perhaps against a time of scarcity.

The shrew has long been noted for fierceness and for its resistance to taming. If two or more are placed together in a cage, they will fight until only one is left, and the victor will eat his vanquished companions. No successful method of keeping the shrew in captivity has yet been devised, and a captive will usually die within a day or two. Scientific name of masked shrew, *Sorex cinereus*; of eastern short-tailed shrew, *Blarina brevicauda*. The photograph is of a European long-tailed shrew, *Sorex araneus castaneus*.

BAT

SIZE: Little brown bat, total length, $3\frac{1}{2}$ inches; tail vertebrae, $1\frac{1}{2}$ inches.

RANGE: Little brown bat, from the Atlantic coast to the Rocky Mountains, north nearly to the limit of trees in the Arctics, south to the Gulf of Mexico. There are many other species of bats found in all parts of North America except in the treeless Arctics.

The bat is the only mammal which can really fly, though several other mammals can glide downward through the air, as does the flying squirrel. In the bat the fingers of the fore limbs are greatly lengthened and are connected by a thin membrane, which is continuous to the hind limbs and, except in the case of the free-tailed bats, to the tail.

The little brown bat is one of the smaller North American bats, but none of our bats are nearly so large as the fruit-eating bats of the Old World, some of which have a length as great as fourteen inches and a wing spread of four feet. In color the little brown bat is dull grayish-brown, somewhat paler below, and the flying membranes are blackish. In this bat the ears are small, but in some other American bats they are very large. The eyes of all our bats are small.

Bats are active almost entirely at night. Many kinds spend the daytime in a cave or in a hollow tree. These kinds of bats often



Courtesy, Bureau of Biological Survey

The bat is the only mammal which can really fly

make use of the attics of buildings or of spaces in the walls. There are other kinds of bats which hang themselves up from the branches of trees. All bats have the claws of the hind feet arranged to serve as hooks, and they commonly hang head downward when resting. It is interesting that the cave-inhabiting bats are able to fly about in absolute darkness without striking the walls. Some delicate sense other than sight warns them of the presence of solid objects, and they are able to fly through narrow cracks without striking a wing.

During the summer one to four young are born. The mother prepares no nest but carries the young about with her until they are large enough to hang themselves up alone. Then she will leave them hanging up while she is away feeding. The food of our North American bats is mostly flying insects taken on the wing. Enormous numbers of mosquitoes and other injurious insects are eaten, and the North American bats are wholly beneficial animals. Bats harbor a number of insect parasites, some of these being interesting wingless flies; but none of these parasites, so far as known, will attack man, and the widespread belief that bats introduce bedbugs into houses is unfounded. Neither is it true that bats are inclined to fly into and entangle women's hair.

Certain species of our bats perform extensive migrations, going south in winter just as birds do, but the full extent of these migrations is not known. Some species escape the shortage of insect food, which occurs in winter, by hibernating in caves or crevices. Scientific name of little brown bat, *Myotis lucifugus*. The illustration is of a Mexican free-tailed bat, *Nyctinomus mexicanus*.

WEASEL

SIZE: Eastern weasel, total length of male, 16 inches; tail vertebrae, $5\frac{1}{2}$ inches. The female is considerably smaller.

RANGE: Eastern weasel, the eastern part of the United States from southern Maine to northern Alabama, and west to Illinois. Other species range over practically all the rest of the United States.

The weasel is known by its very much elongated, almost snake-like body, long neck, small flat head, and moderately long tail. Like the snake, it is adapted for moving rapidly through thickets of grass stems or of other vegetation. Its body is so slender that it can readily enter small crevices between rocks or the burrows of



Courtesy, Bureau of Biological Survey

The weasels in summer are brownish above and white or yellowish below. In winter many of them turn pure white, except for the tip of the tail.

small rodents. The least weasel, indeed, is so small that it can enter the burrows of even small mice, and these therefore have no means of escape from its attack. The weasel, furthermore, is so powerfully muscled and its teeth are so sharp that it is able to attack and kill rabbits and other animals much larger than itself.

As a machine for killing, the weasel is probably unequaled among land animals. Besides its strong muscles and its exceptionally quick and nervous movements, it has sharp eyes, keen ears, and a well-developed sense of smell. It is able to track and find rabbits and other prey by scent alone. The weasel is probably our only animal which kills wantonly. Long after it is satiated with food it will continue to kill, apparently purely for the joy of killing. Often it will merely suck the blood or eat the brains of its prey, disdaining the remainder of the body. In the chicken house it will not desist until it has killed every fowl within reach, or until the aroused farmer has ended its life with a well-directed charge of shot.

The food of the weasel includes mice, ground squirrels, chipmunks, tree squirrels, quail, ducks, and many other kinds of small mammals and birds. Most of the animals eaten belong to the harmful rodent tribe, and the weasel therefore is in general an ally of the farmer. Only occasionally does one get into the habit of raiding the poultry roost. But its depredations among the rabbits

and game birds have earned it the enmity of gamekeepers and sportsmen, who class it among the "vermin."

Although the eastern weasel is usually found on the ground, it is an agile climber and is able to pursue chipmunks and squirrels through the branches of the trees. Its favorite habitat is in deciduous forests and in brushy thickets, but it hunts also along streams and over meadows. Other species prefer the plains, the northern tundras, or the mountains.

The nest may be in a burrow dug by the weasel itself, or use may be made of the deserted burrow of some other animal, of a hollow tree, or of some other cavity. In this nest is born one litter of young at some time between April and June. Four to six is the usual number of young, but as many as twelve have been found in a single litter.

The weasels in summer are brownish above and white or yellowish below, the end of the tail being black in all except the least weasel, which has only a short tail, with no more than a few black hairs on the tip. In wintertime the northern weasels turn pure white except for the ends of their tails, which remain black. But in the warmer parts of the continent the weasels do not turn white in winter, though they become somewhat grayer than in summer. In intermediate regions, as in southern Michigan, some of the weasels turn white in winter, while others of the same race in the same localities remain brown.

The fur of the weasel is soft and fine, and when taken in the white winter coat is called "ermine." Owing to the small size of the animal the skins of many individuals are needed for even a small wrap; hence the fur is high in price. Scientific name of eastern weasel, *Mustela noveboracensis*; of least weasel, *Mustela rixosa*.

OPOSSUM

SIZE: Total length, 25 to 30 inches; tail vertebrae, 10 to 15 inches.

RANGE: Atlantic coast from New York to Florida, west to Texas, north to southern Wisconsin and eastern Nebraska.

This curious animal is about as large as a large cat. It is covered with thick coarse hair of a general grayish-white color. The underfur is white with black tips. The long overlying hairs are white. Its snout is much like that of a pig. Its sharp pointed face is like that of a large rat. Like a rat's, too, is the long hairless tail, but the opossum can use the tail, as some monkeys can, to cling to the



Courtesy, Bureau of Biological Survey

The opossum is covered with thick, grayish-white hair. The underfur is white with black tips; the long overlying hairs are white

branches of trees. The opossum's toes are long, slender, and widely spread, and can be used like a hand for grasping. The footprints show every toe distinctly and are different from those of every other animal.

The strangest thing of all about the opossum is the pouch or pocket on the mother's abdomen, where she carries her babies. This pouch is very much like that of the kangaroo in Australia. When the baby opossums are born, they are tiny, hairless, helpless little creatures about as big as mice. They remain in the pouch for about six to eight weeks. Even when they are able to run about, they return to the pouch for shelter and protection until the family becomes too large for it. Sometimes the mother arches her tail over her back and the little ones cling to it by their tails.

Opossums may be found in most parts of the eastern United States but they are most abundant in the South. They like to live near the water and are most numerous about swamps and along streams. They make their homes in hollow trees, in holes under the roots of trees, or in some similar place where they can hide by day. At night they go about in search of food. In cold weather they retire to their dens and only occasionally venture forth. They eat all sorts of plant and animal food, including insects and other small animals, grain, fruits, and vegetables. They destroy some of the farmer's pests such as the destructive cotton rat, but they also

sometimes catch some of his chickens and eat them. The flesh of the opossum is edible and is especially prized by the negroes in the South. The fur is also of some value.

The opossum is a slow-moving and rather stupid animal. If overtaken by an enemy, it falls down in a limp ball and lies perfectly still, pretending to be dead. This is called "playing 'possum."

Opossums are the only animals in North America which belong to the order of Marsupials, or pouched animals, of which the Australian kangaroo is also a member. The opossum of the eastern United States is known as the Virginia opossum. Scientific name, *Didelphis virginiana*.

GROUNDHOG OR WOODCHUCK

SIZE: Total length, 22 to 27 inches; tail vertebrae, 5 to 6 inches.

RANGE: Eastern woodchuck, from Virginia, northern Alabama, and northern Arkansas north to western North Dakota, Hudson Bay, and Labrador; west in Canada to British Columbia and Yukon.

Like a few other rodents, or gnawing animals, this curious animal does not lay up stores of food for the winter, but sleeps all winter long. During the summer and fall, it eats just as much as it can and gets very fat. As soon as the weather begins to turn cold it curls up into a nice comfortable roll in its deep burrow and hibernates until warm weather comes again.

The groundhog is a heavily built animal, with coarse hair, broad, flat head, short neck, short bushy tail, and powerful legs. Its toes have strong claws for digging. Its color is a grizzled brown. Its only note is a short shrill whistle which it sounds when alarmed.

The groundhog is a burrower. Little mounds of earth mark its burrows on the sides of hills, under rocks in woods, under old stumps, or even out in the open grassy fields. It seems to like best to live in the woods. Its burrows often slant upward so that water may not enter. They wind about underground in all directions. One or more of the tunnels lead to a small inner room well lined with dry grass and leaves. It is here that the three to nine young are born in April or May.

The groundhog feeds on grasses, alfalfa, clover, and vegetables in field and garden, where it sometimes does much damage. Its flesh, though occasionally eaten, is not very good and its coarse-haired pelt is worthless as fur.



Photograph by J. E. Hupp

Courtesy, U. S. Forest Service

The groundhog, or woodchuck, is a heavily built animal. Its coarse hair is a grizzled brown color

According to an old groundless superstition, the woodchuck is looked upon as a weather prophet. It is claimed that on February 2, "Groundhog Day," it wakes from its long sleep and goes to the entrance of its burrow to see what the weather is like. If the sun is shining and it sees its shadow, it curls up for another six weeks of sleep, and we are supposed to know that there will be six more weeks of winter weather. If it does not see its shadow, there will be an early spring and the groundhog at once starts its search for food. Scientific name of eastern woodchuck or groundhog, *Marmota monax*. Several other forms occur in the West, in Canada, and in Alaska.

RED FOX

SIZE: Total length, about 3 feet; tail, about 14 inches.

RANGE: Throughout Canada, and in the eastern United States as far south as the Carolinas. Originally absent from the Southeastern States but now introduced. Other species occur in parts of the West.

Smaller and weaker in body than its relatives, the wolves, the fox has had to depend for its very existence upon its cleverness. The fox has a more delicate skull than the wolf, a more pointed



Photograph by C. W. Pooler

Courtesy, U. S. Forest Service

The red fox is so called because of the yellowish-red fur of some animals. But the color of this fox varies, as is described in the text

muzzle, larger ears, a longer, more bushy tail, and usually longer and finer fur.

The red fox gets its name from the yellowish-red fur of some individuals. But the color of this fox varies. Sometimes it has black markings in the shape of a cross on its back, and it is then called "cross fox." Other individuals are all black, except for a white-tipped tail. Still others are black with many white-tipped hairs that give them a silvery sheen. These "silver foxes" are rare and their fur is highly prized and very costly. In some places in Canada and the United States are fox farms where silver foxes are reared.

In its natural state the fox lives in an underground den which it digs for itself or in the burrow of some other animal which it adapts to its own uses. These dens always have two or more entrances opening in different directions, so that if an enemy comes in one door the fox can escape through another. The young, numbering generally from four to nine, are born about the first of April and are tenderly cared for by both parents.

The fox uses all sorts of tricks to throw the hunter off the trail. Often it will go back in its own tracks and then leap away to one side and go off in another direction.

The fox eats ground-nesting birds of all kinds and their eggs; mice, rabbits, reptiles, insects; and many kinds of fruits. It has a bad name among the farmers, for it sometimes carries off their chickens. But it pays for this by killing large numbers of mice and other crop-destroying animals. Scientific name of eastern red fox, *Vulpes fulva*.

ELK OR WAPITI

SIZE: Total length of male, 7 to 9 feet; of female, about 7 feet; tail, about 5 inches; height at shoulder, about 5 feet. Weight of male, 600 pounds to 700 pounds. Horns of a record bull, 64 to 66 inches along the beam.

RANGE: Formerly over southern Canada and northern United States nearly from coast to coast. Now confined chiefly to northern parts of the Rocky Mountains.

The American elk or wapiti is a stately and handsome animal and is, next to the moose, the largest member of the deer family in North America. Its spreading, many-branched antlers give it a majestic appearance. In the autumn, during the mating season, it



Photograph by F. Rush

Courtesy, U. S. Forest Service

A herd of elk seeking winter range in the foothills of a northern forest

has a bugle-like call. During this period the males engage in fierce fights for the possession of the females. The elk is yellowish-brown on the upper parts, darker on the sides and underbody, with a well-marked yellowish or whitish patch on the rump. On the neck is a growth of long coarse black hair.

In the spring and summer each elk usually goes about alone. In the winter they gather in large herds, which are constantly on the move, seeking food. The food of the elk is varied. It thrives equally well on the boughs and bark of trees, or on grasses, mosses, and lichens. Because of this and because of its hardihood, it is not difficult to rear in captivity. One or three young are born at a time in late spring. They are spotted like the fawns of other deer. Scientific name of eastern wapiti or American elk, *Cervus canadensis*. The American elk is closely related to the European stag, while the moose is almost identical with the European elk. The early settlers of America applied the name elk to the wrong animal, but the name now is firmly fixed in our language.

DEER

SIZE: Virginia or white-tailed deer, length of male, 5 to 5½ feet; tail, 10 inches; height at shoulder, 3 feet; weight, up to 225 to 300 pounds. Female, somewhat smaller. Mule deer, length of male, about 5½ feet; tail, 7 inches; average weight, 150 to 200 pounds; length of female, about 4 feet 9 inches.

RANGE: Virginia deer, from Atlantic coast to the Rocky Mountains and from the Gulf of Mexico to southern Canada. Mule deer, from the Great Plains west to California, and eastern British Columbia south to Mexico, north to southern Manitoba and Alberta.

Members of the deer family may be known by their antlers or branched horns. Usually the male alone bears antlers, although in the reindeer both sexes have them.

Most deer are slender, graceful creatures and are exceedingly nimble. They have beautiful large, lustrous eyes. Their ears move about freely and are as expressive as their eyes. Their bodies are covered with short brittle hair, which forms a heavier coat in the winter than in the summer.

The antlers are renewed each year. They begin to grow in the spring and do not attain full growth until fall. At first they are covered with a dark hairy skin, known as velvet and carrying a



Photograph by Elwin R. Sanborn

Courtesy, The New York Zoological Society

The Virginia or white-tailed deer is the best-known member of the deer family in North America

rich supply of blood to nourish the growing antler. When the antler is mature, the circulation of blood is cut off and the velvet dies and peels off, leaving the hard bony substance. In the late winter the antlers are shed. The first year the antlers are not branched, but, in general, each year another tine is added, until the full number of branches is attained.

The best-known member of the family in North America is the Virginia or white-tailed deer. Its wedge-shaped tail, snow-white underneath and on the edges, flashes like a signal when the startled animal dashes to cover. The general color of this deer when grown is brownish-gray in winter and rusty red in summer. There are white markings about the eyes and across the nose. The fawns, or young, are dull rusty brown spotted with white. They look like the ground spotted with light when the sun shines through the leaves, and when they lie quietly they can scarcely be seen. The young of most deer are spotted in this way—an excellent example of protective coloration.

In the summer the white-tail usually wanders alone through the forest or in parties of two or three. In the winter it gathers in herds,



Photograph by K. D. Swan

Courtesy, U. S. Forest Service

The mule deer, so called because of its large, mule-like ears, is larger and heavier than the white-tail

sometimes of a considerable size in deer yards, and keeps a network of paths open through the snow in order that it may reach the bushes and trees which furnish the chief food at this time. In the summer it eats a great variety of herbs and grasses, aquatic plants, berries and other fruits, and beechnuts.

The mule deer is larger and heavier than the white-tail. It gets its name from its large mule-like ears. The antler has the main beam double-branched in the shape of the letter Y, in contrast to the white-tail, in which the antler has a main beam which is curved forward. In the mule deer the base of the tail and a disk around it are white, but the tip is black. The high, bounding leaps of this

deer when suddenly alarmed are very characteristic. It is more lordly in bearing and less timid and cautious than the white-tail. While the white-tailed deer is most at home in the hardwood forests, the mule deer is found most commonly in open forests and in brushy thickets. Scientific name of the Virginia or white-tailed deer, *Odocoileus virginianus*; of the mule deer, *Odocoileus hemionus*. In the Southwest and on the Pacific coast are found other species of deer.

BOBCAT

SIZE: Total length, about 36 inches; tail vertebrae, $6\frac{1}{2}$ inches.

RANGE: Over most of the wooded and brushy parts of southern North America from Nova Scotia and Ontario to the Gulf of Mexico, and from Mexico to British Columbia.

The bobcat is very seldom seen even in places where it is rather abundant. Living usually in dense forests or thick brush, it moves silently and cautiously and keeps well hidden. Being ever on the alert, it usually detects the approach of a person long before it is itself seen, and crouches behind some leafy screen. However, it has



Photograph by Frank Morley Woodruff

The bobcat is a reddish-brown color above, lightly spotted and streaked with black. The underparts are white

a considerable amount of curiosity and is said at times to follow in a man's footsteps, apparently to observe his actions. The bobcat never attacks man or child, though if cornered it is well able to defend itself with teeth and claws.

The bobcat is slightly smaller than the Canada lynx (see p. 305) and the tufts of hair on the ears are much shorter. In the bobcat the underside of the tail is white to the tip, while in the Canada lynx the whole end is black. In color this wild cat is rufous brown on the upper parts, lightly spotted and streaked with black. The underparts are white. On account of its color it is sometimes called "bay lynx." The name bobcat refers to its short tail.

The food of the bobcat consists of mice, rabbits, squirrels, quail, grouse, and many other small mammals and birds. It can climb trees easily, but spends most of its time on the ground. Its home is made in small caves or in hollow trees. The young number from two to four and are born in the spring.

Rarely the bobcat will raid an unprotected roost of the farmer's chickens, and has been known to kill lambs and fawns. As a destroyer of rabbits, ground squirrels, and other rodents, it is beneficial to the farmer, but its destruction of insectivorous birds must be counted against it. Gamekeepers have blacklisted it on account of the damage it does to grouse, quail, and other game birds. Its flesh is said to be excellent eating. Scientific name of eastern bobcat, *Lynx ruffus*.

BLACK BEAR

SIZE: Length, 5 to 6 feet; height at shoulder, about 30 inches; tail, 5 inches; weight, 200 to 400 pounds.

RANGE: Greater part of wooded North America.

Bears appear to be clumsy beasts, but are among the most interesting of all animals to watch. Their bodies look heavier than they are, for they are covered with long coarse hair. Their legs are short and thick and they walk flat-footed, like a man. In walking they lift both feet on one side of the body at the same time. This causes them to wobble from one side to the other. They are not really so awkward as they look. They can run very fast, though not for a long distance. The black bear can climb trees and is a good swimmer. The bears can stand on their hind feet and even walk a little this way, looking very droll.

*Photograph by M. J. Valentine**Courtesy, U. S. Forest Service*

The black bear is usually all black except for its brown muzzle

The black bear is usually all black except for the muzzle, which is brown. Some bears are a cinnamon brown color instead of black. The cinnamon bear is not a distinct species, but is merely a color variation of the black bear. Cinnamon cubs are born in the same litter with black ones.

The bear does not store up food in holes and burrows, as the squirrel and chipmunk do, but stores it up instead in its own body in the form of fat. Through most of the summer and autumn, gathering food and eating it is its chief business. When cold weather comes it dens up alone in a natural cave, a hollow tree, a hole under an upturned tree, or a den which it builds for itself. The young are born during the hibernating period. At birth the little cubs are surprisingly tiny creatures, no larger than guinea pigs. They have almost no fur and their eyes are closed. They are so helpless that their mother must care for them for several months. There are from one to four cubs in a litter.

Fierce and powerful as it looks, the black bear is really a very shy and inoffensive creature. It does not attack people except when wounded or in order to defend itself or its young.

Bears live largely on vegetable food—fruit, berries, bark, roots and tender shoots, corn, and nuts. They also eat any kind of game they can capture, but they are not swift and agile enough to be very good hunters. They are clever at fishing and fish often forms an important part of their diet. Insects seem to be considered a

great delicacy by bears, for they will spend many hours tearing rotten stumps to pieces in search of fat grubs or turning over stones to lick up the ants and other insects hidden there. They are exceedingly fond of honey and will go to no end of trouble to get it. They raid the settler's fields for green corn and sometimes carry off pigs.

Scientific name of American black bear, *Ursus americanus*. The grizzly bears of the West are larger and more powerful than the black bear. In most states they are rapidly being exterminated.

COUGAR

SIZE: Total length, 7 to 9 feet; tail vertebrae, $2\frac{1}{2}$ feet.

RANGE: Formerly from Quebec and Vancouver Island south over nearly the whole of the United States and Mexico, and extending on south over Central and South America to Patagonia. Numerous species are represented over this great range. Now exterminated in many parts of North America.

Next to the jaguar, the cougar is the largest of the cat family living in North America. It is called also puma, mountain lion, or panther. The color is a pale tawny-brown or grayish-brown, with-



Courtesy, The New York Zoological Society

The cougar is a pale tawny-brown or grayish-brown color, without spots

out spots. The young, however, are spotted, and this is believed to indicate that the ancestors were spotted, perhaps something like a jaguar. The tail is long and heavy.

The cougar, especially the male, is a great wanderer, hunting over many square miles of territory in a regular route. During the day the animal lies up in some convenient cave or under a tree, for it is ordinarily not active except at night. The young, one to four in number, are born in a nest placed in a shallow cave or under the thick, low-hanging branches of a tree. They may be born, at least in the Southwestern States, in any month of the year.

Although the cougar is a powerful animal, it is very timid and rarely attacks man. There are only a few authentic instances of such attack on record. In South America, it has even the reputation for protecting man against the attack of the more aggressive jaguar. The cougar has a wild scream, said to resemble the scream of a woman or child. Heard at night in the woods this weird cry has caused many nervous persons to imagine that they were about to be attacked.

The cougar kills many deer for food and is also very fond of colts. Rabbits and other small mammals are sometimes eaten. It will probably kill almost any of the larger game or domestic animals when opportunity offers. It has caused so much damage to domestic livestock that it has been relentlessly hunted, and its numbers are now much reduced. It is to be hoped that it will not be completely exterminated, but that a few of these interesting animals will be allowed to remain in some national park or other wild refuge. Scientific name of eastern cougar, *Felis couguar*.

MAMMALS OF THE NORTHERN FIR-SPRUCE FORESTS

MARTEN

SIZE: Total length, 25 inches; tail vertebrae, 8 inches.

RANGE: Northern North America, from ocean to ocean, wherever there are heavy coniferous forests; south in the Rocky Mountains and Cascade Mountains to New Mexico and California. Several different races occur.

The marten is one of the most graceful and beautiful of our forest animals. In appearance it is very much like a large weasel, of



From drawing by Ernest Thompson Seton

Courtesy, Bureau of Biological Survey

The marten much resembles a large weasel, to whose family it belongs. Its coloring varies greatly in different regions

whose family it is a member. In color the American marten is rich yellowish-brown above, except for the head, which is light gray. The legs and tail are blackish. On the throat and chin is a bright patch of yellow, white, or orange. However, there is much variation in color in the animals from different regions and even from the same region, and to secure a matched series of skins for a fur wrap is a difficult task. The feet are large and in the winter serve as effective snowshoes, so that the animal is able to travel on very soft snow.

The marten is at home mostly in the northern fir and spruce forests, where it spends part of its time in the trees. It can climb even more actively than the squirrels and can capture them in fair chase among the branches. It feeds also upon snowshoe hares, weasels, chipmunks, mice of many kinds, grouse and smaller birds and their eggs, frogs, fish, and insects. It also eats some kinds of wild fruits. It is extremely active and never seems to tire. But it is very shy and quickly disappears before the approach of civilization.

The nest is made of grass, moss, or leaves and is placed in a hollow tree, among rocks, or in some other cavity. One litter consisting of one to eight young is born in early spring. After the young leave the mother in the fall each one lives alone, and except during

the mating season each animal is fiercely antagonistic to all others of its kind. It is this antagonism that has prevented the successful establishment of marten fur farms.

The fur of some marten is as beautiful as that of the closely related Siberian sable, and the fur of even the paler-colored animals is very attractive and valuable. For the sake of its pelt the marten has been relentlessly trapped, and it has become much reduced in numbers in all districts and completely exterminated in places. Scientific name of eastern marten, *Martes americana*.

CANADA LYNX

SIZE: Total length, about 3 feet; tail, 4 inches.

RANGE: From the northern limit of trees south to northern United States; in the mountains south to California and Colorado, formerly to Pennsylvania.

The Canada lynx is well fitted for a life in the northern forests. Its thick soft fur keeps out the cold and its large heavily-furred feet enable it to walk on the softest snow. Its pale gray winter color harmonizes well with the snow-covered landscape, helping it to approach its prey without being discovered.

The Canada lynx is larger than its relative, the bobcat (see p. 299).



Courtesy, Bureau of Biological Survey

The general color of the Canada lynx is grayish-brown in summer, with black markings. In winter it is much paler and grayer.

The ear tufts are also much longer in the Canada lynx, the feet are larger, and the end of the tail is black all around. Its general color in summer is grayish-brown, with markings of black; in winter it is much paler and grayer.

The food of the lynx includes mice, squirrels, grouse, and other small animals and birds. It has also been known to kill mountain sheep. Its chief prey, however, is the snowshoe hare. The hare population in the North fluctuates in abundance from year to year, reaching a maximum of numbers about every five or ten years. When the hare is abundant, the lynx has a plentiful supply of food and multiplies rapidly. When the hare suddenly becomes scarce, the lynx is left with a much reduced food supply and thousands starve miserably.

From two to five young are born in the spring of the year, the nest being located in a cavern or hollow tree. The young are marked with spots and bands, which is thought to indicate that the ancestors of the lynx were more spotted than the present animal. The mother and the young remain together for nearly a year.

The trail of the lynx in the snow consists of only a single set of tracks, for the animal has the habit of stepping each time in its previous footsteps. Trappers sometimes set a trap in the snow beneath one of these tracks, and the lynx, in its next passage, is very likely to be caught. The fur of the lynx is valuable, and its numbers have been greatly reduced by the trappers. Scientific name of the Canada lynx, *Lynx canadensis*.

GRAY WOLF

SIZE: Length of male, about 5 feet; tail, about 16 inches. Female, somewhat smaller.

RANGE: Originally throughout North America north of the tropical region, except in deserts. In many regions where it was once numerous it is now rare or extinct.

Although a first cousin of the dog, man's best friend among the animals, the wolf is sometimes considered one of man's worst enemies. Many stories are told of hungry wolves attacking and devouring men. But most of these tales are either greatly exaggerated or entirely untrue, and wolves are so shy that they are rarely seen. They do prey sometimes upon man's domestic animals, however, killing sheep, cattle, and, more rarely, horses.

The gray wolf of North America is now found chiefly in the conifer



Courtesy, Bureau of Biological Survey

The gray wolf has coarse yellowish-gray overhair and soft warm underfur

forests of Canada and in the wooded mountains of the West. It is often called the "timber wolf." It has coarse yellowish-gray overhair and soft warm underfur. The ears are erect and pointed, the muzzle sharp. The plains wolf, which formerly followed and preyed upon the herds of bison, was paler in color, but similar in general habits.

In the spring a pair of wolves will retire to a natural shelter, such as a rock cave, or to a hollow dug by the mother herself. There, in March or April, from five to twelve pups are born. The mother shows great devotion to her young, and the male also aids in bringing food to the family and in protecting the young. All through the summer, while small game is easy to procure, the wolves lead a comparatively peaceful existence. When winter comes and the struggle for existence becomes harder, they unite in packs, combining their strength and wits to overcome the larger animals. Wolves show their relationship to the dog in their intelligence; in fact, the dog is only a domesticated wolf. They are very keen to detect traps or poisoned baits and for this reason are very hard to catch. This explains why, in spite of man's warfare against them, they have not been exterminated.

A wolf will eat any kind of animal food. Mice, rabbits, squirrels

deer, and even elk and moose are among the wild animals which it devours. When flesh is scarce it is said wolves will sometimes dig up and eat certain roots. The fur of the wolf is used commercially to some extent. Scientific name of eastern gray or timber wolf, *Canis lycaon*; of plains wolf, *Canis nubilus*.



Courtesy, Bureau of Biological Survey

The red squirrel, which is about half the size of the gray squirrel, is of a rusty red color, with white underneath

RED SQUIRREL

SIZE: Total length, 12 inches; tail vertebrae, 5 inches.

RANGE: Eastern red squirrel, forests of Alaska and Canada, south to Idaho, Wyoming, Wisconsin, Indiana, District of Columbia, and along the Alleghenies to South Carolina. Related species are found in Colorado, and in the Southwestern States, on the Pacific coast.

Of all the squirrels the little red squirrel is the liveliest, the boldest, the sauciest, and the most mischievous. It is only about half as large as the gray squirrel, and is of a rusty red color, with white underneath. When young, red squirrels delight in chasing one another up and down and 'round and 'round the trees. When they are older they often fight in earnest. Often a red squirrel will attack and drive away its larger cousin, the gray squirrel. Towards man the red squirrel is bold and impudent. If you come close to it, it does not usually run away, but will stare at you and scold you

loudly and excitedly. In addition to its barking, scolding, and chattering notes, the red squirrel also has a pleasing song.

The red squirrel is a good swimmer and will sometimes cross streams or lakes to move to a place where the food supply is better. It likes best to live in forests of pine, hemlock, spruce, and other cone-bearing trees. The nests are made of twigs, leaves, and moss and lined with bark or other soft material. They are usually hidden in various kinds of places, as in knot holes of trees, or on limbs near the trunk of a tree, in the ground under roots, stumps, logs, and brush heaps. Several litters of four to six young a season are born.

The red squirrel does not hibernate, so gathers in the fall great stores of cones and places them around the base of a tree or under a log. From these cones it extracts the seeds during winter. In some places it makes inroads upon the farmer's stores of grain. The red squirrel's worst habit is that of robbing birds' nests and eating the eggs and young. It also eats buds, roots, mushrooms, and berries. Scientific name of eastern red squirrel, *Sciurus hudsonicus*.

PORCUPINE

SIZE: Total length, about 35 inches; tail, about 6 inches; weight, up to 30 or 40 pounds.

RANGE: Eastern porcupine, forests of eastern North America from the Mackenzie River and Labrador south to Wisconsin, Pennsylvania, and northern New England. Other forms occur in western North America from Alaska to California and Arizona.

Probably no animal has a better means of defending itself than the porcupine. Its body is covered with an armor of very stiff, sharp-pointed, many-barbed spines or quills from half an inch to three inches long. Usually these quills lie flat, but when the animal is excited it raises them by means of special muscles on the underside of the skin, so that they stand out like spikes in all directions. In addition, it has a powerful tail, likewise armed with spines on the top and sides. This tail it swings about, and woe betide any animal close enough to be struck by it! The spines, loosened from the skin of the porcupine, become embedded in the skin of the victim, causing intense pain and sometimes death. The porcupine



Photograph by W. M. Rush

Courtesy, U. S. Forest Service

Long coarse black hairs and yellowish-white quills, tipped with black, give the porcupine a blackish appearance

does not "shoot" its quills, as is commonly supposed, but it is easy to see how this idea arose.

The porcupine of North America is a stout, heavily built animal. It has short legs and feet which rest flat on the ground, like those of the bear and the raccoon. Intermingled with the spines, which are yellowish-white but black on the tips, are long coarse black hairs, giving the animal a blackish appearance. The porcupine is sometimes incorrectly called a hedgehog (a name properly applied to a small insect-eating animal of the Old World). It is a rodent, belonging to the same great order as the rat and the squirrel.

Porcupines live chiefly in forests, and pass much of their time in the trees, although they have their dens in caves, under the shelter of large rocks, logs, or piles of brush, or in hollow trees. They are stupid and very sluggish in their habits.

Except during the severest weather the porcupine does not hibernate. During extremely cold days it remains in its den, but as soon as there is a slight rise in temperature it goes out in search of food. In the winter the food consists chiefly of the bark of hemlock and of other trees. The porcupine destroys many branches by girdling the bark. In the summer it eats all sorts of vegetable food—buds, fruit, and leaves. It is particularly fond of lily pads. It is very fond of salt and will often invade camps to gnaw barrels or boxes that have contained salted meat. It will even gnaw the handles of axes

or canoe paddles which have a taint of salt derived from the perspiration from men's hands.

From one to four young are born at a time, about the first of May. The young are remarkably large and appear fully armed with spines at birth. Before they are half grown they wander forth to look after themselves.

The white man has found little use for the porcupine and it is considered a nuisance for the damage it does around camps and because it frequently blunders into traps set for valuable fur animals. The Indians use its flesh for food and the quills for making small baskets and for various kinds of ornamentation. Scientific name of eastern or Canada porcupine, *Erethizon dorsatum*.

WOODLAND CARIBOU

SIZE: Total length of male, 6 feet; tail vertebrae, 6 inches.

RANGE: From the northern edge of the spruce and birch forests of Alaska and Labrador north to British Columbia, northern Idaho, northern Minnesota, and Maine. Related species are found over the barren grounds of the arctics.

The caribou differs from all the other deer in that the female usually has antlers as well as the male. The antlers are very long and much branched, those of the male being larger than those of the female. At the branches the antlers are much flattened. The muzzle is entirely covered by hair. In summer the general color of the woodland caribou is dark brown; the underparts are paler, and a band just above the hoofs is nearly white. In winter the general color is gray, with the head and neck nearly white. The hair is very thick and, as each hair is hollow and filled with air, the animal is provided with exceptionally good protection against the cold and wind of the long northern winter.

The legs of the caribou are short, giving it a stocky appearance. In movements it seems clumsy, and it lacks the grace of the deer or the majesty of the elk. But it has great endurance and can travel long distances even over bad ground. Its hoofs are large and broad and in winter have sharp edges, adapting it for walking on marshy ground or on ice or crusted snow.

Although found most frequently in the forests of spruce, fir, and birch the woodland caribou also frequents bogs and marshes and the edges of streams and lakes. Occasionally it wanders out onto the barrens, so frequently found in the arctic regions. In summer



Photograph by Elwin R. Sanborn

Courtesy, The New York Zoological Society

The woodland caribou is dark brown in summer; in winter it is gray

the cows, calves, and younger animals are found in small groups, while the bulls are solitary or are found only several together. In winter they all unite to form large herds, but the woodland caribou never gathers into such immense herds as the barren ground caribou sometimes does. There is usually one calf, in June, rarely twins.

The food of the caribou in summer consists of many sorts of green herbs, swamp plants, and the buds of willows and of other trees and shrubs. In winter the favorite food is the reindeer moss, a lichen growing abundantly in places in the open woods and in bogs. Often the animals dig down through several feet of snow to secure this plant.

The American caribou are close relatives of the reindeer, which has been domesticated from an allied species found in northern Europe. In northern Canada and parts of Alaska the flesh of the caribou forms an important part of the food of the people, and its skin is used for making fur garments and bedding. Unfortunately, the animal is easily killed by hunters armed with high-powered rifles and it has been exterminated in many sections. Scientific name of eastern woodland caribou, *Rangifer caribou*; of barren ground caribou, *Rangifer arcticus*.

MOOSE

SIZE: Eastern moose, male, length, $8\frac{1}{2}$ to $9\frac{1}{2}$ feet; tail, $2\frac{1}{2}$ inches; height at shoulders, $5\frac{1}{2}$ to $6\frac{1}{2}$ feet; average adult spread of antlers, 52 to 58 inches; record heads, 65 to 68 inches. Female, smaller than the male. The Alaska moose is larger, record antlers reaching over 77 inches.

RANGE: Southern Canada west to the Rocky Mountains, north to Alaska, south to northern New England, northern Michigan, and northern Minnesota, and in the Rockies to Wyoming.

The moose is the most powerful and also the most ungainly of the deer family. It has long legs and a very large head, with a large oddly shaped nose, and great antlers. Under the neck is a pendulous



The moose is the most powerful member of the deer family. It is very dark brown in color

fold of skin, known as the bell, which in old age draws up into a sort of pouch. The color of the moose is a very dark brown. A large male or bull moose sometimes weighs as much as 1,400 pounds and the antlers may have a spread of more than six feet. The antlers are flat, unlike those of most members of the deer family, which are rounded. Each antler is shaped like the palm of the hand turned upward and has a number of prongs at its edge. The front legs are longer than the rear ones and this makes the gait of the moose extremely awkward. The long stiltlike legs are extremely useful in enabling the animal to travel with ease through deep snow in winter.

In spite of its huge size the moose can move through the thickest brush very quietly. Its home is in the northern forests, where it feeds chiefly upon leaves and twigs. In summer it shows a fondness for marshy country, ponds, and lakes. It often wades in water up to its neck in order to pull up lily roots or other aquatic plants. Moose, unlike the elk, do not go about in large herds, and are often found solitary, but the young remain with the mother until they are about one year old. In winter several may be found feeding together in what are known as "moose yards," which they keep open by tramping down the snow. Usually the moose is timid, but in the autumn during the mating season the male becomes very bold and will fight furiously with its front feet and its heavy antlers. One or two young are born at a time in the spring or summer. Unlike the young of most members of the deer family, the young of the moose are not spotted. Scientific name of eastern moose, *Alces americanus*.

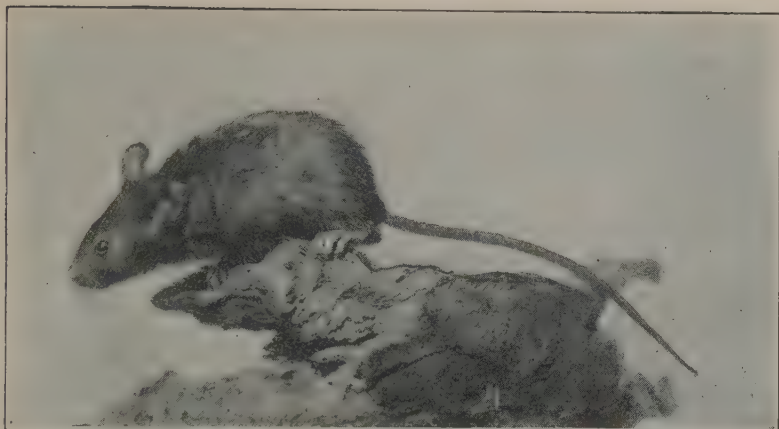
MAMMALS FOUND AROUND BUILDINGS

HOUSE MOUSE

SIZE: Total length, 7 inches; tail vertebrae, $3\frac{1}{2}$ inches.

RANGE: In practically all regions inhabited by man.

The little gray mouse with its bright beady eyes, its rather slender body, and its long hairless tail is a frequent and unwelcome visitor in our homes. Originally it lived in Asia, but it has traveled all over the world and now makes its home in almost every land where man lives. Mice are very destructive to food, clothing, books, and papers, and they multiply so rapidly that they very



The little gray house mouse is found in practically every region in the world that is inhabited by man

soon overrun a house unless the utmost vigilance is exercised.

Mice breed several times each year and there are from four to nine young in each litter. The baby mice are blind, naked, and helpless when they are born, but they grow fast and soon have families of their own. The mouse builds its nest in some out-of-the-way corner of bits of cotton, wool, or other soft material. It works by night, and it hides so well and moves so quickly and quietly that it is hard to catch. Scientific name of house mouse, *Mus musculus*.

BROWN RAT

SIZE: Total length, 14 to 17 inches; tail vertebrae, 6 to 7 inches.

RANGE: Throughout most of the world.

One of the most despised of all creatures on the earth is the common house rat or brown rat. It does more damage than many larger and more powerful animals. In the general shape of its body and its hairless tail it is like the house mouse, but it has coarser, browner hair, and is much larger.

Rats make their home in dwelling houses, in barns, in stores, warehouses, in ships, and in underground passages such as sewers. Often, too, they live in the fields in burrows which they dig in the ground. Their nests are made of cotton, wool, or cloth cut into shreds. Rats increase with enormous rapidity. They breed several



Courtesy, Bureau of Biological Survey

The common brown rat is probably the worst pest man has to fight times a year and the young rats average about ten to a litter.

Rats are probably the worst pest known to man. They destroy great quantities of food, spoiling more than they eat. On farms, in addition to destroying both growing and stored crops, they kill many young chickens, turkeys, and other poultry. They damage furs, carpets, leather goods, and fabrics. They sometimes cause floods by gnawing through water pipes, and damage foundations and other parts of buildings. They carry disease from place to place. Bubonic plague has been carried by the fleas on rats to more than fifty countries. Scarlet fever, typhoid, diphtheria, and other diseases are possibly also spread by rats.

When the food supply becomes low in a place where there are many rats, they migrate into other districts, sometimes traveling in large companies. Once a place has become infested with rats, it is very difficult to get rid of them. Buildings should be made rat-proof so far as possible. Heaps of rubbish should be removed. Poisons and traps are of some service, though rats are very wary of these. Scientific name of brown or Norway rat, *Rattus norvegicus*. In seaports and in the Southern States occur the black rat, *Rattus rattus*, and the roof rat, *Rattus rattus alexandrinus*.

MAMMALS FOUND ON HIGH MOUNTAINS

ROCKY MOUNTAIN SHEEP

SIZE: Male, length, about 5 feet; height at shoulder, 40 inches; tail, 3 to 5 inches; horns, 40 to 50 inches around curve. Female, smaller.

RANGE: High mountain ranges from the lower Colorado River and Sonora into British Columbia and Alberta.

Far up in the mountains beyond the highest point where trees will grow is the home of this wild sheep, which is sometimes called the "bighorn" because of its great curving horns. It is a beautiful animal, strong, graceful, and agile. Without a misstep it bounds lightly from point to point, up or down a steep or rocky slope that men could scarcely climb on hands and knees.

The Rocky Mountain sheep is of a grayish-brown color. The horns of the male, or ram, curve backward and then downward in a wide sweep. The female, or ewe, has very much smaller horns. Some close relatives of this sheep are the Stone Mountain sheep of the northern Rockies, which is of an iron-gray color and is sometimes called the "black" mountain sheep; and the Dall Mountain sheep of Alaska, which is pure white.

The Rocky Mountain sheep remains high up in the mountains



Photograph by T. J. Watkins

Courtesy, U. S. Forest Service

The Rocky Mountain sheep has a grayish-brown color

until the winter snows drive it down to the foothills. Early in the spring it returns to the heights. Here the young, numbering one or two, are born. The little lambs are safe from most enemies, but are sometimes carried off by eagles.

The bighorn has been much sought by hunters and in spite of the difficulty of securing it, so many of these sheep have been killed that they have become very rare. Scientific name of Rocky Mountain sheep, *Ovis canadensis*; of Stone Mountain sheep, *Ovis stonoi*; of Dall Mountain sheep, *Ovis dalli*.

ROCKY MOUNTAIN GOAT

SIZE: Male, length, 4 feet; tail, $5\frac{1}{2}$ inches; height at shoulder, 3 feet; horn along front curve, 10 inches. Female, somewhat smaller.

RANGE: In the higher mountains, from Alaska south to Washington and Montana.

Although it is a clumsy-looking animal, the Rocky Mountain goat is as sure-footed as the Rocky Mountain sheep. It has been said: "He gets over the ground and climbs the loftiest peaks 'by



Photograph by E. O. Blankenship

Courtesy, U. S. Forest Service

The Rocky Mountain goat has small black horns and black hoofs. It is covered with long white shaggy hair

main strength and awkwardness.'” As a matter of fact, it is well adapted for climbing. Its hoofs are so built that they hold equally well on snow, ice, or bare rock.

The Rocky Mountain goat is really more closely related to the antelopes than to the goats, and is quite different from the domestic goat. It is about twice as large as the ordinary domestic goat and is covered with long white shaggy hair. It has small black horns and black hoofs. The head is long and ungainly; the body, heavy and humped at the shoulders like that of the buffalo; the legs, short and thick. The female is more slightly built than the male.

The endurance of the Rocky Mountain goat is remarkable. All through the summer it remains on its bleak mountain heights, feeding on the scanty vegetation found among the rocks. In winter it descends lower into the forests. When there is no grass to be had, it can live on dry moss. Scientific name of Rocky Mountain goat, *Oreamnos americanus*.

PIKA

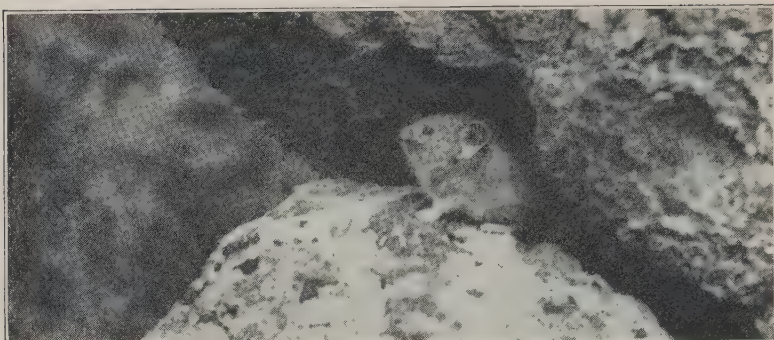
SIZE: Total length, 7 to 8 inches.

RANGE: From southern Alaska south over parts of western Canada, and in the western United States south to northern New Mexico, southern Utah, and the southern Sierra Nevada Mountains; mostly confined to the upper parts of high mountains. Three species and numerous subspecies are recognized.

The pika is a close relative of the rabbit and is frequently called “rock rabbit” or “cony.” It differs from the rabbits in having short ears and short legs, but its fur is very rabbit-like. It is about the size of a small guinea pig, and like that animal it has no external tail. The color of the back varies in the various races from smoke gray to buff, cinnamon, or tawny. There are no conspicuous markings, but the gray-headed pika found in parts of California has the head decidedly grayer than the back.

The habitat chosen by the pika is the piles of rock formed at the bases of mountain cliffs and the similar areas of slide rock so often found near the summits of high mountains. This kind of habitat is found mostly near or above timberline.

Through the crevices between the rocks the pika makes its paths, and its home is in some cavity under the stones. For running over the rocks it is fitted with soft hairy pads on the feet and is able to run up quite steep surfaces. The young, usually three or four in



The color of the pika varies from smoke gray to buff, cinnamon, or tawny number, are born from late May to early September. There are two or perhaps three litters in a season.

The presence of a colony of pikas on a rock slide is indicated by their cries. The cry varies somewhat in the different species, but often is a nasal bleat sounding like "Enk, enk." The animals are rather shy, but if you will sit quietly on the rock slide, they will soon begin to run about and call. They are most active in the early morning and evening and on cool days, and can sometimes be heard calling under the rocks at night.

The food of the pika consists of a variety of grasses and other herbaceous plants and the leaves of deciduous shrubs and trees. Excepting the conifer trees, almost any plant is utilized which grows on or near the rock slides. As the pika is active all the year, even when the rock slide is covered by many feet of snow, it must store food for the winter. This it does by making hay. Grasses, herbs, and leaves are cut and piled in a heap under some sheltering rock exposed to the air. Here the plants dry and cure into hay. Some of these "haystacks" contain as much as a bushel.

The pika has numerous enemies. It can escape the birds of prey by hiding under the rocks; and the bear and other large carnivores are seldom able to dig it out; but the weasel is able to follow through the rock crevices and works havoc in the colony. Scientific name of gray-headed pika, *Ochotona schisticeps*.

Lee R. Dill

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FISHES

AGASSIZ used to say: "If you study Nature in books. when you go outdoors you cannot find her. . . . This is the charm of studying from Nature herself; she brings us back to absolute truth wherever we wander."

We are giving you here some little lessons on common food fishes. But, you should look at real fish (perhaps at the market, if no living specimens are available) and learn to believe whatever the fish tells you, no matter how the lesson in the book reads. The reality, of course, is always what Nature herself tells.

In the text we have told a few things about each of several market fishes, and we have secured some good pictures. As you see, these are all in the flat—two-dimension pictures—while every real fish has a third dimension, not only length and breadth, but also thickness. You will soon learn a few more points, not shown in the picture, from any fish you look at. The fish has two sides, just as you have. These are just alike, only reversed, that is, right and left. A tree, for example, is not built in that way, but a dog is, and a horse, and a boy.

You will notice too that in the case of the dog or horse the long axis of the body is horizontal; it is held up by a leg under each corner. This is true of all the fishes we show here. But the legs and arms of the fish have all their joints under the skin. The parts that appear outside, standing for both arms and legs, are divided into many rays or slender pointed parts something like the ribs of an umbrella. The fish uses his arms and legs in the water to help him paddle along, not to pole himself as a frog does by touching the bottom of the pond.

Thus he needs more than four limbs (fins) in his business; he must have one along the back to keep him steady. The front half of this is often made up of stiff, sharp spines.

The perch, sunfish, and bass all have this arrangement. The sucker and the trout have nothing of the kind, their fin rays being all soft. On the lower side of the fish is, on the middle line, another fin which also helps to keep him upright in the water. At the end of the tail of the fish is a broad fin like a great oar, and by sculling with this the fish throws himself forward. In some cases this tail fin is very broad and strong and sends the fish ahead at a great rate, sometimes as fast as a train of cars can go.

You will notice too that the fish has flat scales overlapping like shingles on a roof. These are sometimes very large, as in the shad, and sometimes very small, as in the trout. In some fishes, like the shad and the trout, the edges of the scales are smooth. In other cases, especially in fishes like the perch, which have stiff spines in their fins, the edges of the scales are rough with little prickles. In the sleek catfish there are no scales at all.

To go much farther you should now get a little aquarium. In the brooks you will find plenty of small fishes to put in it. These you can compare with the big fishes in the markets, as shown in our pictures. Then if you watch the little fishes you may find out how fishes breathe, for they are always swallowing water, letting it slip out behind the head in the slits we call gill openings. Inside these gill openings are the gills, slender red strands arranged in four rows, through which the blood circulates and where it is made pure by contact with the air which the water dissolves. Unless it can keep up this swallowing of pure water which has air dissolved in it the fish will not remain alive very long. If we let plants grow in the water they will keep it pure, for all green parts of plants in the sunlight take in carbonic acid gas, the very gas that fishes and men exhale. This gas is a compound of carbon and oxygen. The plant uses the carbon for its tissues and throws out the oxygen. This the fish needs in his growth, and for it he is reasonably grateful. At least that is the way it seems to us as we look at the little fellow in his aquarium tank.

SHAD

The shad is the largest member of the herring family. It is a broad fish with large smooth scales and no spines in the fins. Its color is plain white. Its white flesh has an excellent flavor, but it is exasperatingly full of small slender bones. There are more of these in the shad than in any other food fish. The shad has a small mouth



Courtesy, David Starr Jordan

The shad is a white, smooth-scaled fish

and no teeth, hence it seldom takes the hook. It spends most of its life in the sea, but runs up the rivers to spawn in April. In the Hudson, Connecticut, and other eastern rivers, it runs just while the shad-flower or service bush is in bloom. The shad was introduced in 1877 to the rivers of California and Oregon, where it is now more abundant than it ever was in the East.

The shad belongs to the *Clupeidae* or herring family. Scientific name of the common shad, *Alosa sapidissima*.

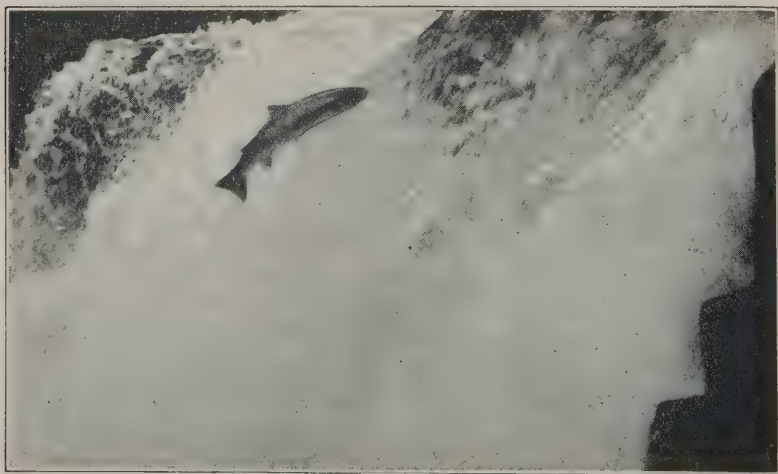
SALMON

All the various kinds of salmon spend their life partly in the ocean and partly in fresh water which they ascend in the spring to deposit their eggs or spawn. As Izaak Walton says, "He has, like some persons of honor and riches which have both their winter and summer houses, this fresh water for summer and the salt water for winter to spend his life in."

The Atlantic salmon of Europe and America is hatched in fresh

water in the spring. There it remains until it is about two years old, when instinct leads it out to sea. About two years later, after it has grown to large size, it returns to fresh water. Swimming upstream, leaping up rapids and over falls, it struggles on, sometimes many miles, until it reaches its destination. The male salmon in most cases washes out with his tail a sort of nest in the gravelly bed of the stream, and the female deposits her eggs in it. In the Atlantic, the salmon lives for several years. But in the five species of the Pacific both parents die after the eggs are laid, and float down the stream tail foremost. All the substance goes out of the body cells and the fish is left as dry as a cornstalk.

Spawning takes place in the fall, but it is not until spring that the baby salmon are hatched. They are queer, shapeless creatures at first. Each one has a yolk sac under its body. This nourishes the little fish until it is able to feed itself. In about two or three months it begins to show red spots and dark markings. Then it changes to a silvery color. The flesh is pinkish orange. When full grown the salmon is very large, averaging in the Atlantic about 25 pounds, and in the Pacific about 18, but sometimes weighing as much as 100. These very large fishes of the species known as king salmon or Chinook are those which have missed spawning at four years, and have remained in the sea for two or three more seasons.

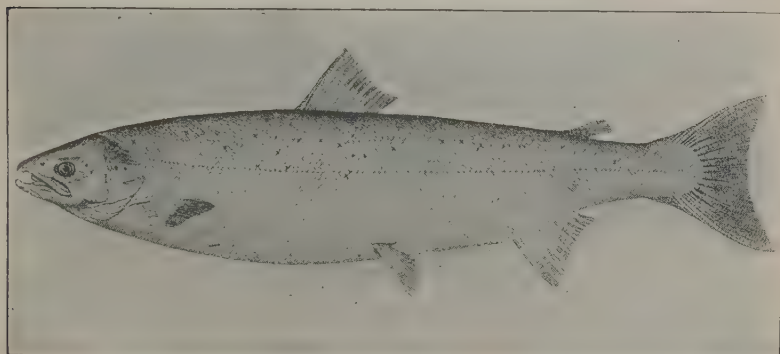


Photograph by Cora Helen Gibson Rockhold

Courtesy, David Starr Jordan

Chinook salmon (king salmon) leaping over Punch Bowl Falls, Oregon. These falls are thirty feet high

In the spawning season the salmon loses its silvery sheen, growing slimy in appearance. The flesh becomes paler, and the snout of the male acquires a long hook. Those who are engaged in the industry



Courtesy, U. S. Fish Commission

The common Atlantic salmon is a silvery color. Its average weight is about twenty-five pounds

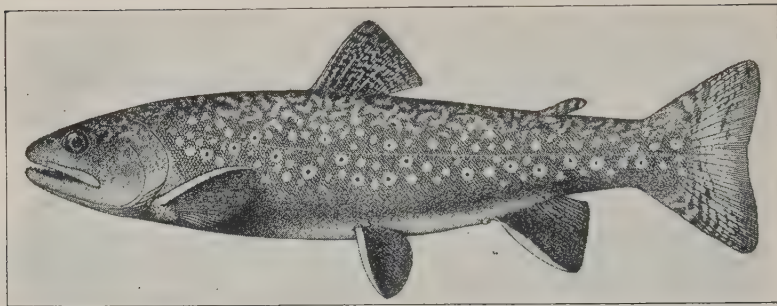
of canning salmon take the fish when they begin their run into fresh waters, some time before spawning.

The family *Salmonidae* includes all the salmon and trout. The red salmon of Alaska, *Oncorhynchus nerka*, is the most valuable food fish in the world. Scientific name of common Atlantic salmon, *Salmo salar*; of Chinook or king salmon, the Columbia River salmon, *Oncorhynchus tshawytscha*. The five species of the Pacific are very different from the salmon of the Atlantic, in which the anatomy and the habits are more like the trout.

BROOK TROUT

One of the gamiest and most active of all fish is the brook trout or speckled trout. It makes a brave fight for its life, but so much has it been sought after by sportsmen that its numbers have greatly diminished except where restored by artificial hatchery. It lives in cold, clear, rapid streams. The eggs are laid in the fall, but are not hatched until the next spring when the water begins to grow warmer.

The brook trout is a small fish as we see in the brooks, but sometimes in cold rivers it reaches a length of 18 inches or more, and a weight of two to six pounds. When it enters the sea and gets

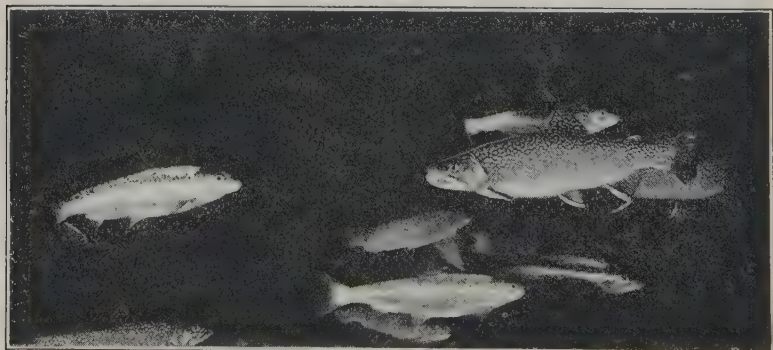


Courtesy, U. S. Fish Commission

The brilliant coloration of the brook trout is described below in detail

sea food, it reaches sometimes a weight of ten pounds. Its color is very brilliant, leading anglers to speak of the "bloom of the trout." The back is mottled or barred with dark olive, and the sides are brightened with many small bright red spots, while the fins, especially the lower ones, have orange and black and white stripes. The scales are very small and deeply embedded in the skin, so that it seems to have no scales at all.

Our brook trout belongs to a group which in England is called *charr* rather than trout. The true trout of Europe, Asia, and Western America have larger scales and are always spotted with black. The charrs, fish of finer substance, are spotted only with red. Both charr and trout are members of the great salmon family known scientifically as *Salmonidae*. Scientific name of eastern brook trout, *Salvelinus fontinalis*.



Photograph by Elwin R. Sanborn

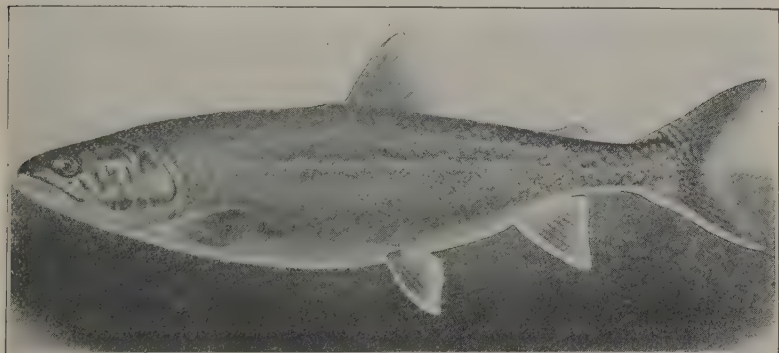
Courtesy, The New York Zoological Society

Specimens of brook trout on exhibition in an aquarium tank

GREAT LAKE TROUT OR MACKINAW TROUT

This is the largest of all trout, sometimes reaching a weight of a hundred pounds. Dark gray in color, it has paler gray spots, where the brook trout has red spots. It is found in the lakes of Maine and New Brunswick, throughout the Great Lakes, and northward to northern Alaska.

Among the fresh-water fishes of America the lake trout ranks next to the whitefish in commercial importance. Many steam vessels are engaged in fishing for these trout by means of gill nets. These are great walls of netting suspended in the water. The fish, swimming along, thrust their heads through the meshes, and their gills catch and prevent them from backing out. Some steam tugs



Courtesy, U. S. Fish Commission

The lake trout is dark gray in color, with paler gray spots, in contrast to the more vivid coloring of the brook trout

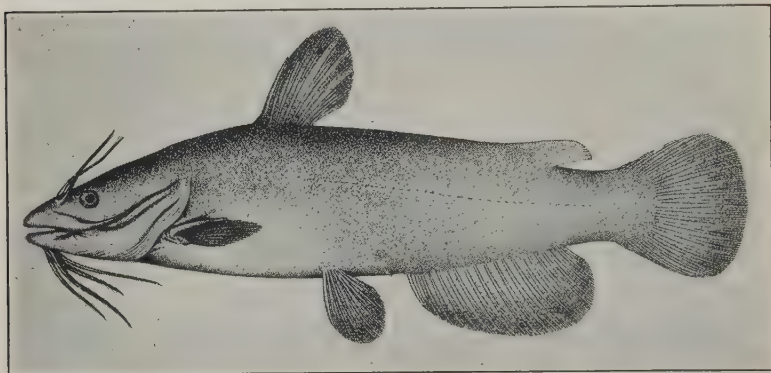
carry five or six miles of nets and catch in one lift several tons of trout.

The Great Lake trout spawn in the shallows and live mostly in deep water at other times. They take bait readily, but go down deep after being hooked.

The lake trout is known as the Great Lake trout, as Mackinaw trout, and in New England as togue. It belongs to the *Salmonidae*. In the Rocky Mountains and westward are more than a dozen other kinds of trout, all energetic and gamy. Most of them, like the trout of Europe, are silvery or olive, covered with round black spots. Several of them have been introduced into eastern waters, especially the one called the Shasta rainbow (*Salmo shasta*). Scientific name of lake trout, *Cristivomer namaycush*.

CATFISHES

There are more than a thousand kinds of catfishes. In the United States there are about thirty, and those you will commonly see are called horned pout or catfish or bullheads. It is easy to see how these fishes got the name catfish, for about the mouth in every one



Courtesy, U. S. Fish Commission

The common eastern bullhead is abundant in every eastern millpond

of the species are long barbels, or feelers, which resemble somewhat a cat's whiskers, though they are much more fleshy, and only four, six, or eight in number.

Almost every boy who has gone fishing knows what bullheads are. These sleek, round-headed, large-mouthed, hungry fishes, common to every eastern millpond, are neither the largest nor the smallest of catfish. In every sluggish stream east of the Rocky Mountains some sort of catfish abounds, and all, big or little, are excellent as food. The biggest and best of them, known as the channel cats, may be distinguished by their deeply forked tails. The blue catfish of the Mississippi Valley is the largest of these and is considered the best of all as a food fish. It has been known to weigh as much as one hundred and fifty pounds, and specimens weighing eighty pounds or more are not uncommon. The common channel cat, a smaller and more active member of this same group, is also found in clear rivers of the Mississippi Valley and of the Great Lakes region, but never in muddy waters.

Catfish have no scales, though some in South America are covered with bony plates. They have a sharp spine on the back fin and one in each of the two forward fins at the sides. For this reason

they must be handled carefully. Their spines are not venomous, but their ragged edges make bad cuts. Almost every boy who is a real boy is marked by these cuts in the summer time. All catfish are comparatively easy to catch, biting readily at any bait. The young of our kinds are carefully protected by their parents, and this explains why the supply holds out in spite of the quantities caught every year.

Several other large species occur in the great rivers of the Middle West. In the small brooks of the West and South are several small kinds, less than six inches long, known as "Mad Toms," because above their long saw-edged spines on the side there is a poison gland which makes a prick from them hurt like the sting of a big wasp.

Scientific name of the American catfish family, *Ameiuridae*; of the blue catfish, *Ictalurus furcatus*; of the common channel cat, *Ictalurus punctatus*; of the common eastern bullhead, *Ameiurus nebulosus*.

CARP

The carp is a dull, sluggish fish preferring quiet shaded waters with muddy bottoms. It has a robust, compressed body, usually covered with large scales. The fin extending along the back is quite long. The head is scaleless; the mouth toothless and rather small, with fleshy lips and short barbels. The carp sometimes weighs as much as forty pounds, but is usually much smaller. It is a native



Courtesy, U. S. Fish Commission

The carp, which was originally a native of China, is now widespread over the world

of Eastern Asia, but was brought to Europe two or three hundred years ago and to America about sixty years ago.

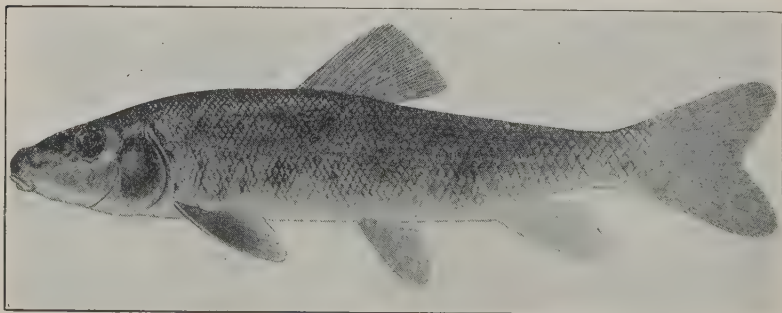
Carp feed upon water insects and other small animals, fish eggs, and the leaves of aquatic plants. It is said that "they can be fed on much the same things as pigs and chickens, and they bear much the same relation to trout and bass that pigs and chickens do to wild game and game birds." In lakes and ponds they root up the bottoms, making the water very muddy and more or less unfit for better fish. Although great numbers are shipped to New York, especially from the western end of Lake Erie, to be eaten as stuffed fish, their quality is poor unless disguised by spices. The writer thinks it a mistake that the carp was ever brought to America, a land which has so many better fishes.

Anglers do not care much for carp because they do not bite freely and are not worth taking home after they are caught. During the winter carp hibernate and do not take food. They spawn about June. The thousands of small transparent eggs cling to weeds and stand much tossing about in the waves. The carp is now widespread over the world, but its native country is China.

The *Cyprinidae*, the carp family, is the most numerous in species of all families of fishes. Scientific name of carp, *Cyprinus carpio*.

SUCKER

There are fifty or more kinds of sucker in the United States, but all with much the same habits. The eastern sucker is known by its thick fleshy lips. It has a long body and a rather conical head which is without scales. The color is dull olive-gray, though in some



Courtesy, David Starr Jordan

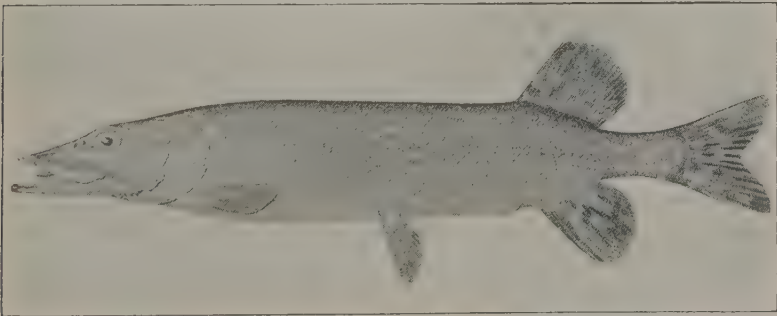
The common sucker is a dull olive-gray color

western species the males in spring take on a rosy color. In the smaller streams the common suckers are only a few inches in length, but in the larger streams and lakes the species reaches a length of two feet. It has no teeth. Its food, consisting chiefly of vegetation, frog spittle, and small sluggish animals, is sucked up from the mud in the bottom of the stream.

In the spring suckers run up the small streams in great numbers to spawn. They do not have any rank as game fishes. They rarely take a hook except by accident. While they are good for food, they are not highly prized, the flesh being soft and flavorless and also beset with small bones.

The largest of the suckers are found in the large rivers of the Mississippi Valley. These are commonly known as buffalo fish. They reach a weight of ten to twenty pounds, but are not highly valued as food.

Scientific name of the sucker family, *Catostomidae*; of the common sucker, *Catostomus commersonii*.



Courtesy, U. S. Fish Commission

The common pike is a greenish- or bluish-gray color, with white or yellow spots and markings

PIKE

The pike has been called "the tyrant of the wat'ry plains," for the whole tribe is notorious for its voracious appetite. It devours great numbers of other fish, as well as frogs, and sometimes water rats and water snakes. It is said to eat an amount equal to about one-fifth of its own weight daily, and is called "a mere machine for the absorption of other organisms."

The white flesh is of excellent flavor. As usually seen the pike is a quiet ruminant fish, lying of choice under pond lily pads, but

darting out with great swiftness at a luckless frog or water snake.

The common pike is easily recognized because of the long head, pointed snout, and slender body, which give it somewhat the appearance of a spear as it darts through the water. Its general color is



Courtesy, David Starr Jordan

The muskellunge is the largest of the pikes

greenish- or bluish-gray, with whitish or yellowish spots and markings. It reaches a length of four feet and a weight of forty pounds or more. In Europe it is said that it sometimes weighs more than a hundred pounds. It is widely distributed in North America, Europe, and Northern Asia. It is probable that the European species called *Esox lucius* is somewhat different from ours, but the two are astonishingly alike.

The pike spawns in spring, in shallow waters. It lays thousands of eggs, which remain entangled in the vegetation until they hatch. The young grow very rapidly. In the winter the pike stays in deeper water. The pike is much prized as a food fish, and is fished for in all sorts of ways and with all sorts of live and artificial bait.

Other members of the pike family are the pickerel, large and small, and the muskellunge.

The muskellunge is by far the largest of the pikes, reaching a length of six to eight feet, and as voracious as it is big. It is spotted or barred with black, and lives in the Great Lakes and the upper rivers of the Mississippi Valley. Anglers prize it greatly.

Scientific name of pike family, *Esocidae*; of common pike, *Esox estor*; of muskellunge, *Esox masquinongy*.

PICKEREL

The smaller members of the pike family are known as pickerel (meaning "little pike"). The common eastern pickerel is of a greenish color, marked with numerous dark lines and streaks. It reaches

a length of about two feet, and a weight of several pounds. It is found only in the region east of the Alleghenies, from Maine to Florida.

Still smaller species are the banded pickerel, found in streams and swamps of the region east of the Alleghenies, and the little pickerel, which belongs to the Mississippi Valley and streams tributary to lakes Erie and Michigan. Neither of these dwarf pickerel is often more than a foot in length.

The habits of the pickerel are much the same as those of the pike. Like the pike, the pickerel is greedy. It will seize a fish half as large



Courtesy, U. S. Fish Commission

The common eastern pickerel has a greenish color, marked with many dark lines and streaks

as itself and swallow it by degrees. Among the favorite methods of fishing for pickerel is "skittering." The bait—a fish, or perhaps a frog or a frog leg—is jerked along the surface, a long rod and short line being used.

The pickerel belongs to the pike family, the *Esocidae*. Scientific name of common eastern pickerel, *Esox niger*; of the banded pickerel, *Esox americanus*; of the little western pickerel, *Esox vermiculatus*.

STICKLEBACK

There are a good many kinds of sticklebacks, and one or more of them live in every trout stream of northern America, Europe, or Asia. Our common three-spined stickleback is a little fish two to three inches long. Each of the species builds a nest. In the spring the male stickleback selects a favorable spot at the bottom of the pond or stream. Here it carries bits of the stems, leaves, and rootlets of water plants, and with sticky threads secreted from its own

body cements them together into a barrel-shaped little structure set horizontally and open at both ends. After the female deposits her eggs in the nest, the male watches over them until they are hatched and cares for the young until they are able to shift for



Courtesy, David Starr Jordan

The stickleback is protected with three sharp spines on its back, and usually with an additional armor of bony plates themselves. But he has the bad habit of inviting in other females until the nest is full of eggs.

The stickleback is protected with three sharp spines on its back (which give it its name) and usually has also an armor of bony plates. It has sharp teeth, and attacks every kind of fish it can reach, biting off pieces of their fins. It does great damage also by devouring the eggs of other fishes. It has one virtue: it feeds on young mosquitoes.

Sticklebacks are found in both fresh and salt water in northern regions whenever they can reach them, but the farther away from the sea they are, the less developed are their spines and bony plates, for only in the sea can they find the salts of lime of which their plates can be made. Those which live far from the sea have no bony shields at all.

Sticklebacks constitute the family *Gasterosteidae*. Scientific name of common stickleback, *Gasterosteus aculeatus*.

PERCH

An interesting family of fishes is that of the perches. They are spiny-rayed fishes; that is, the back fins are made up about half of spines or rays having sharp projecting points.

The yellow perch is the best-known American member of the

family. Its back is olive-green; its sides, golden yellow with six or eight broad bars of black, and its lower fins are red or orange. The usual length is from ten to fourteen inches, and the weight from one-half to two pounds. It is abundant in all streams throughout the eastern states of the United States and as far north as the St. Lawrence River and Nova Scotia, as well as in the upper Mississippi Valley. The yellow perch has been called "everybody's fish," because anybody can catch it with any sort of bait. It is said to be preëminently the boy's fish.

This fish is easily introduced into new waters. The eggs are laid in a single mass, which soon unfolds into a ribbon-like structure, sometimes of considerable length.



Courtesy, U. S. Fish Commission

The yellow perch has an olive-green back, golden yellow sides with broad bars of black, and lower fins of red or orange

Much like the perch, and of the same family, but larger, more active and voracious, with strong sharp teeth, is the pike-perch or wall-eye of the Great Lakes region and the upper Mississippi Valley.

Scientific name of perch family, *Percidae*; of yellow perch, *Perca flavescens*; of pike-perch, *Stizostedion vitreum*.

SUNFISH

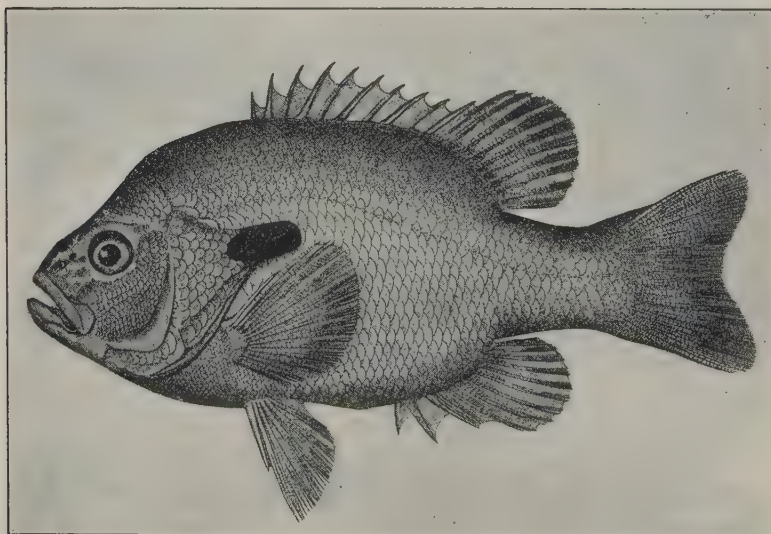
The sunfishes constitute a vigorous and handsome group of river fishes, found in all parts of the United States except in the mountains. There are about thirty kinds, all of the United States.

The members of the sunfish family have rather deep, plump, compressed bodies, and are usually brilliantly colored. They are of small size, being from four to eight inches long, and usually weighing less than a pound. They have spiny fins and are well covered with scales. There is always a black flap at the end of the opercle or gill cover, and this is usually edged with bright red. They are active, gamy fish, and will bite at almost anything, pulling hard when hooked.

The common sunfish of the East, often called "pumpkin seed," with its brilliant orange and golden lights, is a beautiful sight as it flashes through the water. Like the other sunfishes, its colors are brightest in the older fish, and in the clearest waters.

The sunfish scoops out a sort of nest in the bottom of the stream. After the eggs are laid there, they are carefully watched over by the male until they hatch.

The family to which the sunfish belongs also includes the black basses and the crappies, and is scientifically known as *Centrarchidae*. The scientific name of the common sunfish is *Eupomotis gibbosus*. The commonest in the West is *Xenotis megalotis*; that of the South is *Lepomis auritus*.

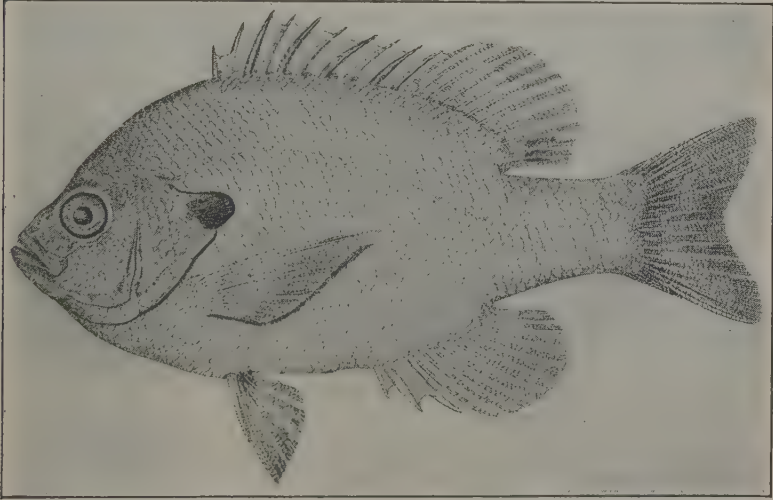


Courtesy, U. S. Fish Commission

The common southern sunfish is a representative member of the brilliantly colored, active sunfish family

BLUEGILL SUNFISH

The bluegill is one of the larger kinds of sunfish, and gets its name from the bluish color of its cheeks and gill covers. It is of a rich greenish-olive color on the back, becoming paler on the



Courtesy, U. S. Fish Commission

The bluegill is one of the larger kinds of sunfish. It is richly colored, with bluish cheeks and gill covers

sides, which are marked with three or four faint dark bars. The fins are all of a greenish color, with always a black spot on the hindmost rays on the back fins. The bluegill reaches a length of twelve to fourteen inches. It is found in lakes and quiet streams from the Great Lakes to the Rio Grande and from western New York to Iowa. It is a boy's game fish and much appreciated. It bites readily and fights vigorously when it finds that it is hooked.

The scientific name of the bluegill sunfish is *Helioperca incisor*. It belongs to the *Centrarchidae* family.

BLACK BASS

These long-bodied and gamy fishes belong also to the sunfish family. There are two species in eastern America, much alike in looks but very different in temper. The large-mouthed black bass lives in ponds and sluggish streams. It is green in color, usually



Courtesy, U. S. Fish Commission

The large-mouthed black bass is green in color, and usually has a dusky band along the sides

with a dusky band along the sides. It takes the hook readily but seems to have little interest in it. The large-mouthed bass is bigger than the small-mouthed, and has larger scales. It reaches a weight of five to eighteen pounds.

The small-mouthed black fish lives in clear, swift streams, and it is extremely active. For the angler it is one of the finest and



Photograph by Elwin R. Sanborn

Courtesy, The New York Zoological Society

Calico bass are silvery olive in color, mottled with green or black spots resembling a calico pattern



Photograph by Elwin R. Sanborn

Courtesy, The New York Zoological Society

Specimens of rock bass shown in an aquarium tank

choicest fishes in the world. A famous angler considers it "inch for inch and pound for pound, the gamiest fish that swims." Its color is dull green with brassy mottlings which often run together in obverse crossbands. This species seldom exceeds two or three pounds in weight.

Both kinds of black bass build nests of gravel, which the male guards with much spirit, especially driving off the female, who is something of a cannibal. When the young come out, he swallows a dozen or so to make good for lost time.

It is wrong to fish for bass in their breeding season, the spring, for to catch one may mean the death of a hundred little ones.

The striped bass is common in the spring in all the eastern rivers. It is brassy silver, with numerous narrow black stripes from head to tail. It is a spiny-rayed fish like the perch and sunfishes, and like them it is active, voracious, and gamy.

Like the shad, it lives in the sea, but runs up the rivers to spawn in the spring. Like the shad also, it has been transferred from the Potomac River to California, where it thrives mightily.

The bass belong to the family of *Centrarchidae*, to which all the sunfishes belong. But all the others are smaller and their bodies are

shorter and deeper. The pictures of the calico bass and the rock bass show this difference clearly. The calico bass, a broad little fish about a foot in length, is silvery olive in color, mottled with green or black spots. Dark and pale spots appear in rows on the median fins and tail. This speckled appearance is responsible for the common name of the fish. The rock bass, which is about the same size as the calico bass, is olive green, with dark mottlings and a dark spot on each scale. It has a black opercular spot, and a red and very large eye.

All of the bass have firm, well-flavored flesh, very much alike. The large-mouthed black bass when living in ponds with muddy bottoms often acquires an unpleasant flavor of mud.

Scientific name of large-mouthed black bass, *Huro salmoides*; of small-mouthed bass, *Micropterus dolomieu*; of striped bass, *Roccus saxatilis*; of calico bass, *Pomoxis sparoides*; of rock bass, *Ambloplites rupestris*.

Daniel Starr Jordan

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INVERTEBRATES

THE invertebrate animals, particularly the insects, outnumber all the other animals and plants of the world put together and are found wherever life exists, from the depths of the ocean to the cellars and pantries of our houses. They force us to pay attention to them whether we view their activities with a sympathetic or a hostile attitude.

Through the activities of the invertebrates we come to understand life in its simpler aspects, but the child may at first more easily understand the animals whose life habits and structure are more like his own. The best rule, however, and one that cannot fail, is to allow the child to study the different aspects of the world that most interest him at any given time. He will usually be more interested in a live animal than in a dead one, and the invertebrates for this reason make the best schoolroom nature-study material. They serve to open up to the child's wondering gaze worlds of reality that will catch and hold his interest with little stimulation from the teacher.

The animals selected for special treatment in the following pages have been chosen from the myriads of kinds found all around us because of their likelihood of finding their way into the schoolroom. Most of them may be readily found by going to the habitat described for each, and they may be brought back alive to the schoolroom for study. The short and rather non-technical descriptions will help the teacher and student to identify the animal; the short discussion aims to point out the more interesting aspects of the life of each animal.

With each description a picture of the animal is shown. In many cases the subjects have been greatly enlarged in order to show the details of the structure of a particular specimen. It is to be hoped, however, that the greater part of the study may be made by observation of the live creature, and that

the illustrations in this department will be used as supplementary material.

Most animal life is relatively inactive during the winter months, but many of the forms described in the following pages may be either found in the winter or collected in the fall and kept alive during the winter in the schoolroom. This is particularly true of many aquatic animals which will often live quite well in a Mason jar, if a better aquarium is not available. A simple insect cage may be constructed for the land animals (see Vol. V, p. 210).

The smaller animals that can be studied only with a microscope have been omitted, not because they are not interesting or because any pedagogical rule is broken by permitting a child the supreme thrill of seeing the wonderful life contained in a drop of stagnant water, but because microscopes are not available to the average elementary-school teacher. A small hand lens kept in the desk, however, will give the children an opportunity to see many interesting structures that will otherwise escape their notice.

If any funds are available to supplement the material brought in by the children, preserved material, together with collecting apparatus, may be secured from the following firms:

Ward's Natural History Establishment, Rochester, N. Y.

General Biological Supply House, 761 East 69th Place, Chicago.

Supply Department, Marine Biological Laboratory, Woods Hole, Mass.

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FLATWORM

Phylum *Platyhelminthes*. Class *Turbellaria*

HABITAT: Under stones in brooks or on lake shores throughout the world.

DESCRIPTION: Medium-sized and small worms, flattened, unsegmented; head end usually contains two eyespots; mouth opening in the middle of the underside of the body.

The flatworm is of great interest because of its lowly organization and its remarkable behavior. If one of these animals is cut in two with a knife, both halves will soon be found swimming about over the surface of the receptacle, the head end traveling faster than its lost posterior half, but the tail end entirely aware which direction is forward. Under suitable conditions, both halves



Slightly enlarged

The body of the flatworm is without a distinct head

will regenerate a whole body, the head end growing a new tail and the tail end growing a new head.

In the subtropics and tropics, a few flatworms are terrestrial, but in temperate regions they are found in all types of fresh-water situations and in shallow salt water. They secrete a slime which probably serves as a protection. The whole surface of the body is covered with microscopic cilia which function as swimming organs. In addition to the slow, gliding motion of the animal over objects under the water, it can move by means of contractions and expansions of the body.

The flatworms avoid light and seek sheltered places, such as the undersurface of the stones in brooks. They feed on animal matter. The tubular mouth or pharynx is usually situated in the middle of the underside of the body rather than in the head.

They are easily kept in aquariums, where their many interesting habits will repay one for the slight trouble of finding them and giving them a home.

SNAILS AND SLUGS

Phylum *Mollusca*. Class *Gastropoda*

HABITAT: Snails are found in all marine and fresh-water situations all over the world and are not uncommon in moist places on land. Slugs are found only in moist places on land.

DESCRIPTION: Snails usually have a spirally coiled shell and well-developed head, but the cone-shaped limpet of our brooks lacks both these structures. Slugs are snails that have a degenerate or atrophied shell.

Snails have always been the symbols of lethargy, but actually they move more rapidly than many others of their mollusk kin. Nearly all the mollusks possess a shell which is carried about with them as a protection against predacious enemies and has probably kept many of them from evolving speed mechanisms. Snails have apparently evolved from bivalves and one of the two shells has become coiled, leaving an opening for the extrusion of the body. The other shell has degenerated and has been reduced to an operculum for sealing the opening or else is entirely absent. In the slugs, the shell is degenerate or absent, and a slimy secretion protects them from their enemies.

Some snails living in water breathe by means of gills, but the common pond snails are descended from snails that at one time



About two-thirds natural size

Snails are among the plant-feeding animals commonly found in our gardens lived on land and they still have to come to the surface to obtain free air.

The snail moves on its broad flat foot. If one is placed upon a piece of thin glass, the muscular waves that move the snail can easily be watched through the glass. On the head are found contractile tentacles, two of which bear eyespots which enable the snail to distinguish light and dark. The shell is a limy secretion from a structure called the mantle and grows with the snail. The lines of the successive growth stages can be seen on the outside of the shell.

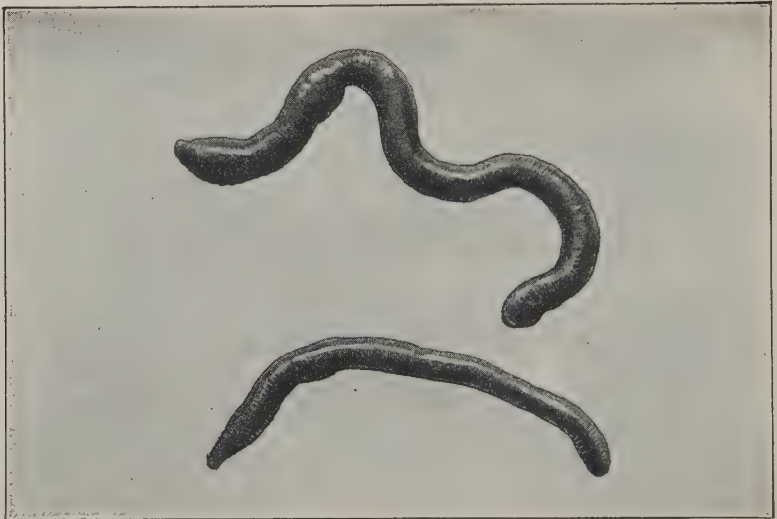
The food of practically all of our common land and pond snails is plant material. Leaves are scraped with a rasping organ in the mouth.

EARTHWORM

Phylum *Annelida*. Class *Chaetopoda*. Order *Macrodrili*

HABITAT: In moist soil all over the world; most abundant in the temperate regions. They should be sought particularly in soil rich in organic matter.

DESCRIPTION: Cylindrical segmented worms possessing setae, or stiff bristles, which one can feel by running the finger toward the head on the underside of the body.



Slightly enlarged

Every earthworm that burrows in the ground helps to circulate the soil

The earthworm deserves more careful study than it usually receives during its utilization by the small boy as an attraction for fish. Anna Botsford Comstock says she is sure that the earthworm was created to serve as food for other animals. It does seem as though this might be the case, for not only fish, but many birds, snakes, and toads find earthworms a delicious dessert, if they do not also serve for the meat and salad courses. These animals have even learned to swallow the earthworm head first, to avoid the embarrassing situation of having their meal crawl out as rapidly as it is swallowed.

Charles Darwin has pointed out another phase of the influence of earthworms, however, in his study of their activities in circulating the soil. He estimates that through the action of worms more than eighteen tons of earth may be carried to the surface on a single acre of land in a year.

Earthworms feed principally upon organic matter which they take into their digestive systems along with dirt. At night they may come to the surface and explore the neighborhood of their burrows in search of pieces of leaves. They also find their mates on the surface of the ground. The organs of both sexes are found in

the same worm. When the two worms come together in the mating process the male region of each individual comes in contact with the female region of the other. Slime tubes are secreted and then a bandlike cocoon is formed in which the eggs of one individual and the spermatozoa of the other are deposited. When, at a later time, these bands slip over the heads, the spermatozoa of one individual fertilizes the eggs of the other, and later the young worms escape from these slime cocoons.

SCUDS OR AMPHIPODS

Class *Crustacea*. Order *Amphipoda*

HABITAT: In fresh and salt water all over the world. Some forms are terrestrial, living in the riffruff line on beaches, but usually found in or near water.

DESCRIPTION: Body compressed laterally, causing the animal to lie on its side when out of the water.

These little crustaceans abound in ponds and brooks and are readily distinguished by the peculiar habit of moving about on their sides when not swimming. In spite of this sidewise walking, scuds are able to direct their motions downward when brought above the surface in a net or clinging to a stone. When swimming



Five times natural size

The fresh-water amphipod crawls on its side

through the water, they do not move on their sides. Some terrestrial forms on the ocean beaches are remarkable for their jumping habits.

Scuds are plant-feeders and are important food for fishes in many localities. They carry their young in brood pouches in the pectoral region until they are fully developed and able to care for themselves.

The breeding season of scuds lasts through the warm months of the year, and it has been estimated that the progeny of a single pair may be over twenty-four thousand during one season.

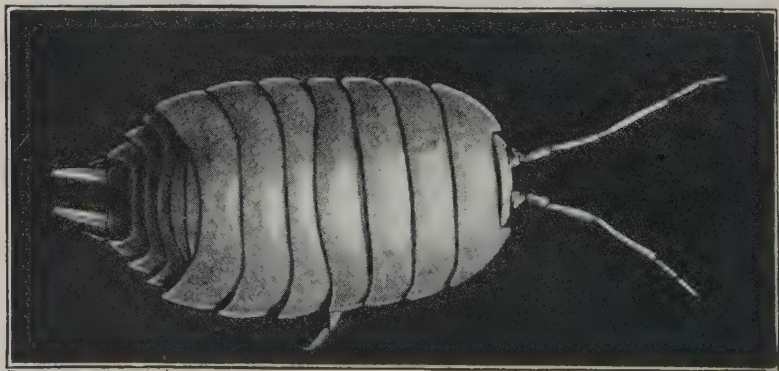
FRESH-WATER SOW BUG

Class *Crustacea*. Order *Isopoda*

HABITAT: In quiet fresh water all over the world. Other sow bugs are found in shallow ocean waters, parasitic in the gills of fish. They are found also in damp terrestrial situations such as old logs and trash in cellars.

DESCRIPTION: Flattened from top to bottom. Five pairs of walking legs on the thorax.

The flattened sow bugs abound in the bottom of ponds and quiet brooks. They resemble their relatives, the scuds, in having five pairs of legs as well as other appendages, but they do not move on their sides. When young they readily eat one another, but when they grow up they become vegetarian in their diet and feed largely upon soft plants, both dead and living.



Four times natural size

The body of the sow bug is smooth or minutely granulate

The young are carried by the mother in a brood pouch underneath her thorax, and, like the scuds, the sow bugs are very prolific, producing about sixty eggs every five or six weeks during the summer.

Terrestrial sow bugs are very common in and under old logs on the ground and are often mistaken for insects. Some species are able to roll up into tight little balls when disturbed.



Natural size

The crayfish has evolved great pincers from one of its pairs of legs

CRAYFISH

Class *Crustacea*. Order *Decapoda*. Family *Potamobiidae*

HABITAT: Fresh-water situations of all types throughout North America, from large lakes, rivers, ponds, and brooks, to swampy soils without open water.

DESCRIPTION: Similar to a lobster in general appearance, with the pair of appendages in front of the walking feet modified for grasping.

Crayfish are probably the best known of all the crustacea because of their size and common occurrence in fresh water. Their strong nipping feet are feared by children, who are nevertheless irresistibly attracted by these pincers to a study of the animal's habits and actions.

Crayfish may be found in all fresh water, from the large lakes and rivers to the smaller ponds and brooks. Some have even for-

saken the open water and burrow through the soil to the ground water in low-lying land. The chimneys at the entrances to the burrows often attract attention. The nippers are largely used for this excavation work, which results in rather intricate underground passageways always leading, however, to the ground water.

Crayfish have two common means of locomotion. When disturbed, they swim backward by rapid flips of the broad, flattened tail. Under normal conditions, they use their walking feet, and move slowly, either backward, forward, or sideways.

They feed largely upon animal food, either dead or alive, and when placed together in an aquarium often dismember and devour their fellows.

The eggs are carried by the mother, attached to her abdominal appendages, where the young cling for a time after hatching.

ORB-WEB WEAVER AND OTHER SPIDERS

Class *Arachnida*. Order *Araneida*. Family *Epeiridae*

HABITAT: Spiders in general are found in all terrestrial locations all over the world wherever insects are found. Some have even become adapted to a life largely spent under the surface of the water. The orb-web weaver is usually found in a sheltered place, particularly under the eaves of houses.

DESCRIPTION: Spiders are distinguished from insects by their eight legs, two body sections, lack of compound eyes, and possession of spinning organs on the posterior part of the abdomen.

The orb-web weaver is perhaps the best known of all the spider groups because of the web of regular design used to ensnare its prey. Other spiders do not always build webs, but pounce upon their prey, and some build irregular webs of different designs.

All spiders live upon the juices of their victims, and they are symbols of predatory existence among all races of man.

The orb-web weaver finds a suitable place with good supports for its web, stretches a thread across the space, and connects the center by radiating lines to the supports or other supporting threads. The silk is spun from organs near the tip of the abdomen, and is manipulated by the feet. It is a fluid which hardens immediately upon contact with the air. Several kinds of silk may be spun by the same spider. The first supporting threads of the orb-web



At the left above is the orange garden spider (*Argiope aurantia*) with its egg sack; at the right is the garden spider in its web. Below is the orb-web weaver, most familiar because of the shape of its web

are not sticky and are composed of many strands. As soon as the "spokes" have been placed, a spiral of non-sticky silk is laid a little distance from the center and attached to all the radiating threads. Then the sticky spiral is begun at the outer edge of the web and is carefully attached to all the radiating lines until it joins the non-sticky spiral near the center. The web is now ready for use, and the spider usually takes up a position in the center and waits for its prey. When an insect is caught in the sticky spiral, the orb-web weaver runs out on the non-sticky radiating lines and quickly winds silk about its prey until it is helpless.

Spiders usually have eight simple eyes on the front of the head and are supposed to be rather shortsighted. The eggs are laid in silken cases which are either attached to the weed stalks, or placed under the bark of trees. The females of some of the running spiders carry the eggs either in the mouth or attached to the abdomen until they hatch. In the latter case, when the young hatch they crawl onto the back of the mother and are carried about for some time.

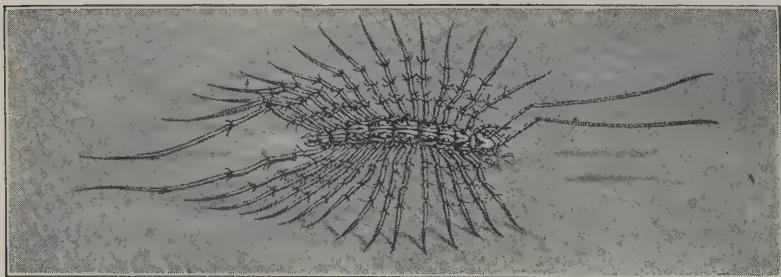
CENTIPEDE OR HUNDRED-LEGGED WORM

Class *Chilopoda*

HABITAT: Over the entire world in damp terrestrial situations, such as under fallen logs, undersurfaces of stones, and basements of houses.

DESCRIPTION: Easily distinguished by the many legs on the abdomen, usually one pair on each segment; relatively rapid motion; strong jaws on the first segment of the body.

In contrast to the millipedes, these animals are very rapid in their motion and when disturbed run so quickly that they are



Natural size

The centipede, except in the tropics, is not dangerous to man

caught with difficulty. Centipedes are entirely carnivorous in their habits, feeding upon insects and other organisms found in the logs and damp situations which they inhabit. On the first body segment are found two large jaws which are connected with poison glands and are thus able to inflict a bite which is painful but not dangerous to man.

One species of centipede is commonly found in houses, attracting attention because of its very long legs and fearful appearance. As a matter of fact, however, this invader feeds upon flies and other household pests, and does us more good than harm.

In the tropics, centipedes a foot or more in length are not uncommon. They should be avoided because of their poisonous bite



Enlarged one-third

The millipede, in spite of its formidable appearance, is quite harmless

MILLIPEDE OR THOUSAND-LEGGED WORM

Class *Diplopoda*

HABITAT: Over the entire world in damp terrestrial situations, such as under dead logs on the ground, under stones, and among leaf debris.

DESCRIPTION: Easily distinguished by the many legs on the abdomen, usually two pairs on each segment; relatively slow motion, and tendency to curl up when disturbed.

When a fallen log is turned over, one often finds these many-legged, slow-moving animals. They usually curl up in such a way as to expose only their hard exterior to the invader, carefully protecting the underside and the many delicate legs. Millipedes do not possess a thousand legs or even a hundred legs in many cases, but the legs are so numerous, two pairs on almost every segment

of the body, that they give the impression of a thousand or more. The motion of their legs in waves as they move slowly over the ground is graceful and fascinating to watch.

Millipedes feed on decaying plants in damp places. They are entirely harmless animals and can be handled without fear. Some are brightly colored and look poisonous, but their appearance is deceitful.

SOME GENERAL ASPECTS OF INSECT STUDY

Insects are the most highly specialized of any of the invertebrates and are very complicated in their habits and life histories. There are certain general aspects of their structure and life habits which should be emphasized, however, no matter what particular insect is chosen for study.

The body of an insect is divided into three general regions. The head carries most of the specialized sense organs, such as the compound eyes, simple eyes or *ocelli*, and the tactile and chemical sense organs on the antennae and around the mouth. The ears, however, are usually located on the feet or abdomen. Several pairs of appendages are found near the mouth; these are used to chew or manipulate the food. The insect with biting mouth parts has an upper lip or *labrum*, a pair of jaws or *mandibles*, a pair of *maxillae*, and a lower lip or *labium*. Some insects suck juices of plants or animals, however, and in these cases the mouth parts are elongated for piercing or form a tube for sucking.

On the next body division, the *thorax*, are located the three pairs of walking legs which have become modified in many cases for swimming or digging. The first pair is on the first segment of the thorax, called *prothorax*; the second pair is on the middle segment, or *mesothorax*; and the third pair is on the posterior segment, or *metathorax*. The wings are found on the second and third thoracic segments and are formed as saclike outgrowths of the body wall. They may, however, be enclosed in a pocket in the early stages of development. The fore wings are often used only for protection and are non-functional in flight, as in the case of the beetles, grass-

hoppers, crickets, true bugs, etc. In some cases one of the pairs of wings has degenerated and only two are found, as in the case of the flies. Almost all groups of insects have wingless forms, but these should not be confused with the young stages of many insects which develop wings slowly, either as external buds or in internal pockets.

Along the sides of the abdomen and thorax are found the openings to the breathing organs. Air enters directly through these little holes to tubes or *tracheae*, which spread out all over the insect's body, carrying air to the tissues.

Insects grow by shedding their skins periodically. No insects except the May flies molt after they attain their wings.

Most insects undergo metamorphosis or remarkable changes in their development. One large group has gradual metamorphosis, in which the young, or nymphs, live in the same situation as the adult, are similar in general appearance to the adult, have external wing pads which grow during each successive molt, and do not possess a pupa stage. This type of development is found among the roaches, praying mantes, grasshoppers, katydids, crickets, termites, cicadas, aphids, and true bugs (*Hemiptera*). Another smaller group have incomplete metamorphosis, in which the young, or nymphs, live in the water and possess tracheal gills, have external wing pads, and do not possess a pupa stage. Such insects as the dragon fly, damsel fly, and May fly have this type of development.

The largest group of insects undergoes complete metamorphosis, in which the young, or larva, looks so different from the adult that no one would guess them to be the same insect unless the life history were known. In such cases the larvae are often found in different situations and with different habits from the adult, and the structural changes to be undergone are so great that a quiescent pupa stage is inserted in the life history, in which the insect undergoes a rearrangement of many of its organs. The wings are developed internally until the pupa stage is reached, many adult structures

may be absent or reduced, and the larvae may possess many extra structures that are not found in the adult. This type of metamorphosis is found among the aphids, ants, beetles, caddis worms, moths, butterflies, midges, mosquitoes, true flies, ichneumon flies, wasps, ants, and bees.

The drama of these remarkable changes is always interesting to the child, as well as to the adult, and the schoolroom will not be a place to be dreaded and avoided if some of these fascinating aspects of life are studied and discussed within its walls.

PRAYING MANTIS

Order *Orthoptera*. Family *Mantidae*

HABITAT: In fields and woods in tropical and warm temperate regions of the world. Two introduced species are found in the

northern United States, but no native species is recorded north of Maryland, southern Indiana, and Illinois.

DESCRIPTION: Easily recognized by the grasping form of the forelegs and the elongated prothorax.

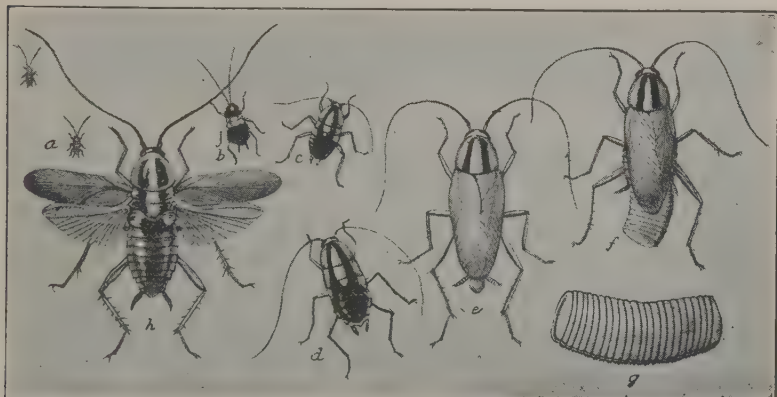


About natural size

The mantis secures its food by grasping other insects with its forelegs

The front legs of these interesting insects are held forward in a prayerful attitude but function in preying rather than praying. The legs are fitted for grasping other insects upon which the mantis feeds, waiting patiently until the victim is within reach before it snatches it up with these spiny legs. One mantis will feed upon another as readily as upon other insects, and it is unwise to keep two in a single cage.

The eggs of the mantis are laid in cases of rather spongelike material. These cases are commonly collected on twigs or grass where the mantis is abundant.



Three-fifths natural size, except egg case

Courtesy, U. S. Bureau of Entomology

The German roach: a, first stage; b, second stage; c, third stage; d, fourth stage; e, adult; f, female with egg case; g, egg case enlarged; h, adult with wings spread

COCKROACH

Order *Orthoptera*. Family *Blattidae*

HABITAT: Rotten logs, leaf débris, and human habitations in all the tropical and temperate regions of the world.

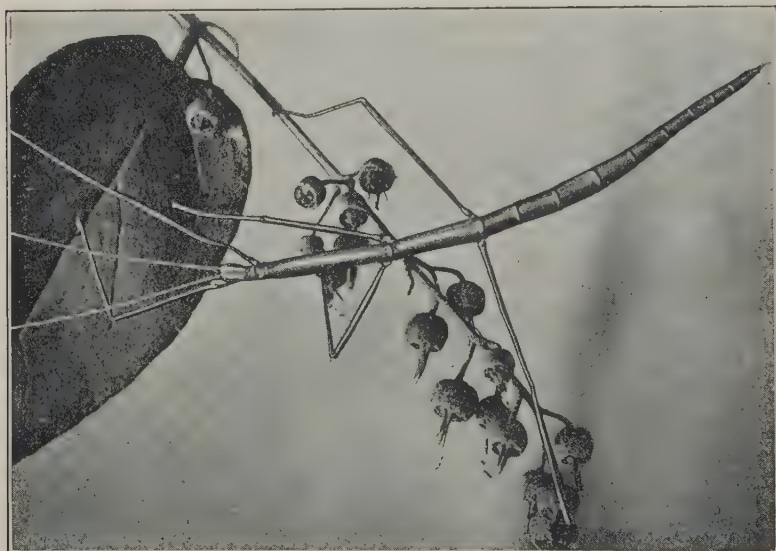
DESCRIPTION: Fore wings of winged forms parchment-like; hind wings folded beneath the fore wings. Legs fitted for running, pronotum usually covering head; body flat.

We do not usually think of the cockroaches as constituting the aristocracy of the insect world, but their family was established in the Coal Age many millions of years before birds or mammals of any sort appeared on the earth. They are found in rotten logs and in leaf débris in the woods, but a few species have become established in our houses and venture forth at night into the pantry to find anything that may have been left after the evening meal. Roaches are omnivorous feeders, eating everything from the coloring matter on book covers to the garbage in our kitchen sinks.

Most roaches lay their eggs in hardened cases called oötheca, each egg contained in a little chamber. The egg case is often found protruding from the end of the abdomen in the female.

Roaches inhabit moist situations and especially like the cracks and crevices in the vicinity of water pipes. They are best eliminated by the frequent use of a volatile oil that can be sprayed in their hiding places.

The most common species which inhabits our houses is the croton bug or German roach which has two longitudinal dark lines on the pronotum, as shown in the picture.



About natural size

The walking stick is one of the most remarkable examples of adaptation to environment

WALKING STICK

Order *Orthoptera*. Family *Phasmidae*

HABITAT: Almost entirely confined to woods and forests in the United States, but having a wider range in other parts of the world.

DESCRIPTION: Elongated, usually wingless insects with legs wide apart and fitted for walking. Resemble twigs.

The walking stick is the fascination of every child who sees this animated twig slowly walking over the ground or projecting itself in true twiglike fashion from a tree. There can be little doubt that

this insect both in appearance and in actions mimics the plants which form its home. It feeds entirely upon leaves and often causes considerable damage to forest vegetation.

The eggs are dropped promiscuously upon the forest floor, where they may remain almost two years before they hatch.

Most of the species in the United States are wingless, but in the tropics occur many winged forms that can fly. Some mimic dead leaves instead of twigs and sticks.

SHORT-HORNED GRASSHOPPER

Order *Orthoptera*. Family *Locustidae*

HABITAT: Wherever there are terrestrial plants, but more abundant in the open grasslands.

DESCRIPTION: Antennae shorter than body; ears on first segment of abdomen; hind legs fitted for jumping.

Although the locusts of the Bible are short-horned grasshoppers, the name locust has been applied, with much confusion, to other insects, such as the cicada.

The short-horned grasshoppers feed on the leaves of plants and often are present in such numbers as to damage vegetation over a great area. They usually lay their eggs in a hole in the ground. Some species make holes in old fences or in rotten logs, where they deposit their eggs and cover the holes with a gummy material.

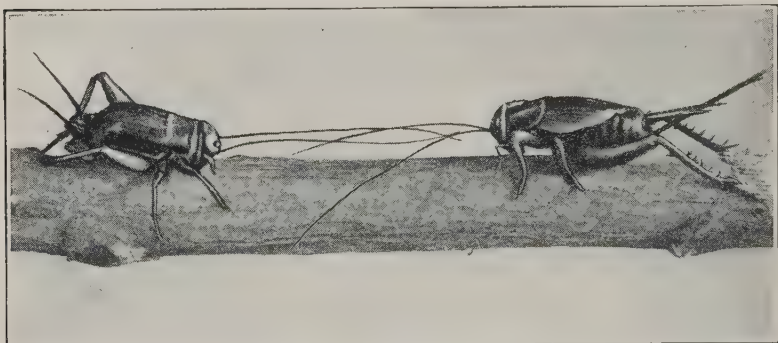
Some species are able to make noises. The crackling noise produced by some grasshoppers in flight is caused by the rubbing of the wings. Others produce a note by rubbing the hind legs upon the outer wings. The ears



About natural size

The short-horned grasshopper

are located on the sides of the first segment of the abdomen. The fore wings are used for protection, and only the folded membranous hind wings function in flight.



About natural size

The crickets are among the best known of the singing insects

CRICKET

Order *Orthoptera*. Family *Gryllidae*

HABITAT: Throughout the world in trees, bushes, and on the ground in fields and woods, particularly under stones or sticks.

DESCRIPTION: Hind legs fitted for jumping; antennae usually longer than body; fore wings lying flat on the back and bent down abruptly on the sides; tarsi three-jointed.

The cheery little black field cricket sometimes wanders into our houses to sing its song, but the "cricket on the hearth" is a European species that lives in houses and has been introduced here.

As is true of the other singing insects in this order, only the male makes the noise. The cricket does this by rubbing the highly modified wings together, one acting as a bow and the other as a string attached to a sounding board.

Most crickets live in the fields under stones or in the grass, where they feed upon plants or insects, not being very particular in their diet. The winter is usually passed in the egg which is laid in the ground. The great host of adults die when the cold weather comes.

In low bushes and trees we find the snowy tree cricket, which is light green in color. The note of this cricket is more continuous than that of its black brother and usually is the dominant note of

the summer insect-chorus in those vicinities where the katydid does not occur. The eggs of the tree cricket are found in the bark of trees and in the stems of plants.

The mole cricket burrows in the ground, using highly modified forelegs, and does not sing like other members of its family.

KATYDID

Order *Orthoptera*. Family *Tettigoniidae*

HABITAT: In trees throughout the United States, east of the Rocky Mountains. Other species are found in the tropics and other temperate regions of the world.

DESCRIPTION: Antennae longer than body; hind legs fitted for jumping; fore wings convex and covering abdomen.

The endless argument as to whether "Katy did," or "Katy didn't," still remains to be settled by these persistent insects that form such an important part of the summer insect-chorus in certain localities. The male does the talking by rubbing his wings together to produce the note.

The katydid feeds upon the leaves of the trees in which it lives, and to no small extent resembles a leaf in appearance.

The eggs are laid in rows on the edges of leaves and are sometimes found with tiny holes, from which have emerged some little parasitic wasps.

False katydids are much more generally distributed than true katydids, but their note is not the same, and the fore wings are not so convex.



About two-thirds natural size

The katydids are beautiful green insects

TERMITES OR WHITE ANTS

Order *Isoptera*

HABITAT: In fallen logs, wooden structures, and under stones, etc., as far north as the northern part of the United States and throughout the tropics and subtropics of the world.

DESCRIPTION: Social insects with different castes; abdomen broadly joined to rest of body.

Reproductive caste—mature female with enlarged abdomen; young males and females with wings which have a crack at the base, where they drop off, or wing stubs, or wing pads.

Soldier caste—enlarged head with powerful jaws; wingless. In some southern species the head is prolonged to serve as a squirt gun for the ejection of a defensive liquid, and the jaws are degenerate.

Worker caste—wingless; head not enlarged; usually whitish in color.

Although more closely related to the cockroaches than to the true ants, these insects have developed a social organization which is as highly specialized as that of any other social insect, and runs more smoothly than human society.

Within a single colony are found several classes or castes, each



Three times natural size

Termites, worker caste. The lower row shows the underside of the body



About four times natural size

Winged males and females, the reproductive caste. Their wings are broken off at the base after the founding of the new colonies

performing a different function, and each structurally and physiologically modified to fit a particular social niche. The workers are wingless, blind, sterile, and composed of both sexes. They perform the ordinary work of the colony, chew and digest the wood which they regurgitate while feeding the other members of the colony, build the nest which in the tropics is often very large, clean and massage the queen, and take care of the eggs and young. The soldiers are large-headed with immense jaws which are not fitted for chewing wood, but serve to defend the colony against any attacker. They also secrete a defensive fluid from a gland in the head which adds chemical warfare to the hand-to-hand combat.

At certain seasons of the year—in June in the northern states—winged males and females swarm forth from the parent colony. They land in some suitable place such as a rotten log and break off their wings along a definite crack or breaking point at the base. The male and female then excavate a small cell where they mate. The first eggs develop into workers and soldiers which take over

the work of securing food and defending the colony. As more workers are produced, the female's (queen's) abdomen grows with the developing reproductive organs until it attains an enormous size. In Africa the queens may reach a length of six inches and lay an average of an egg a second for twenty years or more, but in North America the queens seldom reach an inch in length. The male does not develop an enlarged abdomen, but lives and mates with the queen throughout life.

The reproductive forms developed from winged termites are not so common in North America and Europe as forms that never develop functional wings but remain in the same colony throughout their life. There may be several hundreds of these males and females in a single colony.

Termites feed primarily on wood, often causing considerable damage to human habitations, where they not only eat out the interior of wooden beams, furniture, etc., but attack books and papers. They often remain undiscovered until the damage is complete.

MAY FLY

Order *Ephemera*. Family *Ephemeridae*

HABITAT: In fresh water all over the world. They should be particularly sought among the vegetation and along the borders of ponds and lakes, and under the stones in rapid brooks.

DESCRIPTION: Adult—front wings held vertically when at rest; delicate, transparent, with a great many cross veins; much larger than the hind wings (which may be absent). Antennae minute; front legs held forward; two or three long tail filaments. Nymph—gills in pairs along the sides of the abdomen; three (rarely two) tail filaments.

May flies have long been symbols of ephemeral existence, not only because of the delicacy of the adult winged insect, but because of the very short adult life, which often lasts for only a few hours. The winged forms, upon emerging from the water, alight on a bush or tree near the water and, late in the afternoon or during the twilight period, dance in swarms over the water. Sometimes they are attracted in great numbers to electric lights, particularly in the vicinity of the Great Lakes. The adult takes no nourishment but utilizes the digestive tract filled with air to enhance its buoyancy.

The eggs are deposited in the water, where they hatch into

nymphs which live continuously below the surface of the water, breathing through gills situated along the sides of the abdomen. The nymphs are almost entirely plant-feeders and are found in a wide variety of water habitats. The species found in rapid water are often flat and so formed as to withstand the wash of the moving water as they cling to the stones. The species that live in quiet water usually cling to the plants, or to the stones on the bottom of the pond or lake, or burrow in the silt.

May flies are the only insects that shed their skin after attaining

functional wings. When the nymph is full grown it rises to the surface of the water, the skin splits, and a winged form emerges which later again sheds its skin, wings and all, before the final adult stage is reached.



Slightly enlarged

The May fly sometimes lives only a few hours after attaining adulthood

DRAGON FLY AND DAMSEL FLY

Order *Odonata*

HABITAT: In or near fresh-water habitats throughout the world, such as ponds, lakes, or slowly running brooks and streams.

DESCRIPTION: Adults—four membranous wings with many cross veins; hind wings as large as front wings, or larger; antennae short; abdomen long and slender (more slender in the damsel flies than in the dragon flies); when at rest, wings held vertically in the damsel flies and horizontally in the dragon flies. Nymph—lower lip greatly enlarged and folded beneath the head. In damsel flies, the gills are leaflike, three in number, and situated at the end of the slender abdomen. Dragon flies have no external gills; the abdomen is relatively large and thick.

Dragon flies are the dominant insects above the surface of quiet ponds and small lakes. They fly swiftly back and forth, collecting

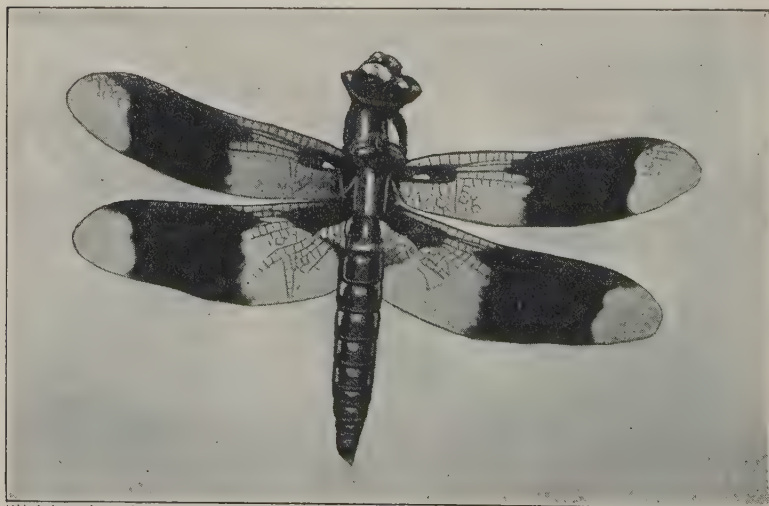


One and one-fourth times natural size

Beautiful iridescent damsel flies are often found clinging to leaves

smaller insects upon which they feed. Hardly less voracious are their smaller cousins, the damsel flies, which live among the plants above the surface of the water but do not venture into the open or as far from the water as their larger relatives.

Underneath the surface, these insects are hardly less carnivorous in the younger stages than in the winged forms. Both the dragon



Slightly enlarged

Dragon flies are of value to man because they feed largely on mosquitoes

fly and damsel fly nymphs have an enormous lower lip, which is thrust forward and serves as an efficient tool for the capture of other insects and water animals. The dragon fly nymph lives on the bottom or under the silt and moves through the water by passively sucking water into the anal cavity and ejecting it with such force that the insect is shot forward through the water. The damsel fly nymph is found in the submerged vegetation, breathing by means of three leaflike gills at the end of the abdomen, and swimming by sidewise undulations, using the gills as a sculling mechanism.

CICADA

Order *Homoptera*. Family *Cicadidae*

HABITAT: Orchards and forests all over the world.

DESCRIPTION: Large insects with wide, blunt heads; sucking beaks, and large membranous front wings, the veins joining at the outer edge.

These large and well-known insects have been referred to under various names, such as locust, lyreman, and harvest fly. The continuous, high-pitched hum of the cicadas is a familiar note in the summer, particularly in the evening, and is caused by the rapid muscular vibration of a membrane behind the thorax. The females do not sing.

One of the most interesting species is known as the "periodical cicada" or "seventeen-year locust." This insect remains seventeen years underground in the nymphal stage, sucking the juices of the roots of plants. It then issues forth from the ground, crawls up the bark of a tree, and sheds its nymphal skin, which is left upon the tree. The nymph possesses digging forelegs not found in the adult cicada, which lives in the trees in summer. The eggs are laid in the twigs. Upon hatching, the nymph drops to the ground and burrows beneath the surface.

Other cicadas do not spend such a long time under the ground, but all have the subterranean stage in their life cycle.



About natural size

The cicada is another of the better known singing insects



Galls formed on leaves by aphids. All species do not produce galls; many aphids are found free upon the stems or leaves of plants

APHIDS OR PLANT LICE

Order *Homoptera*. Family *Aphididae*

HABITAT: Infesting plants all over the temperate regions, but rare in certain parts of the tropics. They may often be seen filling the air for miles as they migrate from one plant to another.

DESCRIPTION: Small pear-shaped insects; winged or wingless; of various colors, but often green or black; with two wax-secreting tubes on the sixth abdominal segment.

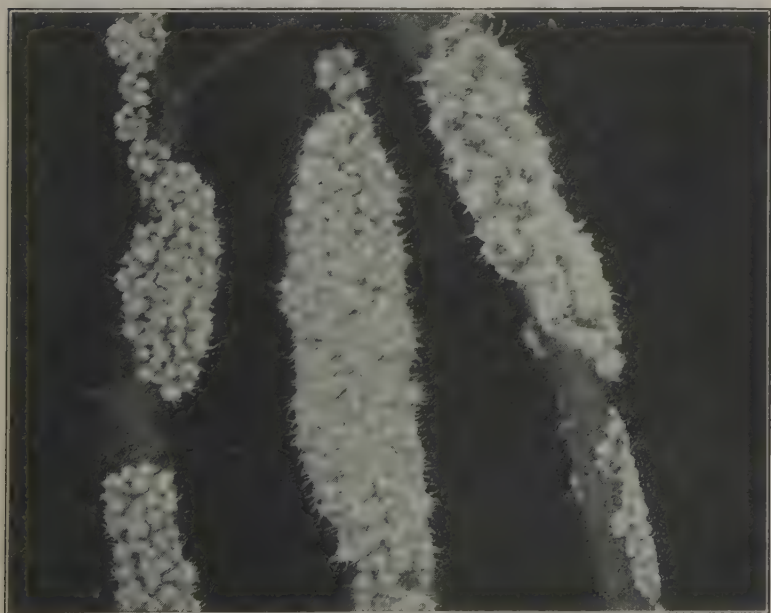
These tiny insects infest every kind of plant, sucking the juices with their beaks, and often causing much damage to the vegetation. The sap of the plant is turned into a clear, sweet liquid on its passage through the digestive tract, and is eagerly lapped up by the ants which often are found on the plants with the aphids. Ants may even care for these "ant cows" during the winter in their nests below the ground. In *Science for the Intermediate Grades*, Volume VIII, page 173, a cross section of an ant hill is pictured in which one compartment is used as a "stable" for aphids.

The seasonal cycle of generations in the typical member of this

family is a marvel of the insect world. Following is a brief summary of the life history of a migrating species:

The wingless stem-mother hatches from an overwintering egg and climbs to the leaves of the plant. She produces alive another wingless generation of females, which also produce live young from unfertilized ova for several generations. Finally winged females are produced which fly to another plant, where again several generations of wingless forms appear born alive from unfertilized ova. Again winged forms appear which migrate back to the original host. These may produce true males and females, which lay the fertilized egg that remains over the winter, and from which the stem-mother hatches in the spring.

Some aphids cause the formation of galls on plants, and others are found free upon the stems or leaves. They have many enemies, ranging from the aphid lion, ladybird beetles, and the larvae of hover flies to tiny parasitic wasps that insert their ovipositors directly into the tissues when laying eggs.



Certain aphids have their bodies covered with white powder or with tiny fringes, which give them a woolly appearance when massed



About natural size

Tiny hairs on the tips of its feet enable the water strider actually to walk upon the water

WATER STRIDER

Order *Hemiptera*. Family *Gerridae*

HABITAT: Surface of quiet or slowly moving water throughout the world. Some species wander far from land on the surface of the ocean.

DESCRIPTION: Adult—elongated body; middle and hind legs long and close together; front legs fitted for grasping prey. May be winged or wingless. Nymph—same as adult but always with undeveloped wings.

Every country child is familiar with the water strider, which skims rapidly over the surface of ponds and slowly moving brooks and streams. Various names, all appropriate, such as “water skip-

pers," and "water skaters" are used for these insects in different parts of the country. Their marvelous ability to walk upon the water is the result of remarkably adapted feet which bear water-repellent hairs on the tips.

Insects that fall upon the surface of the water become the food of the water striders. When congregated near the shore of a slowly moving stream they will come out and examine every bit of floating débris that comes down, but feed only upon the recently entrapped insects.

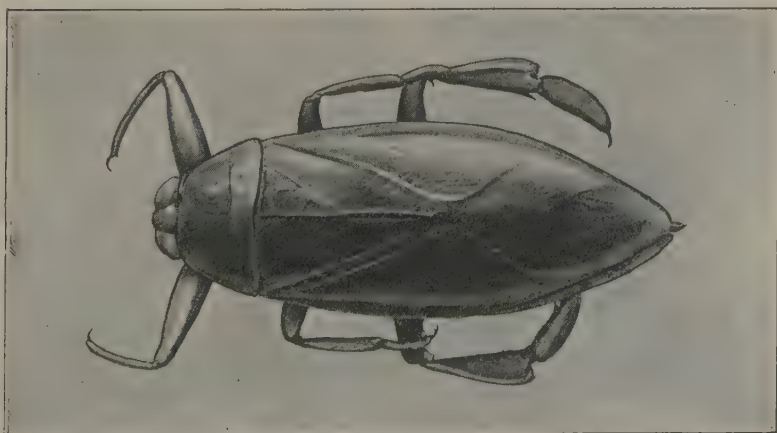
Many of the adults are wingless and are confined with the nymphs to a single pond or stream, but some are winged and serve to populate new environments very rapidly.

GIANT WATER BUG

Order *Hemiptera*. Family *Belostomatidae*

HABITAT: In or near fresh-water situations throughout the world, such as ponds, borders of lakes, or in slowly running brooks and streams.

DESCRIPTION: Adult—front wings thickened at the base with overlapping membranous tips; a short beak on the underside of the head fitted for sucking the juices of prey; front legs fitted for grasping prey. Large, flat-bodied, oval. Nymph—same as adult but wings not fully developed.

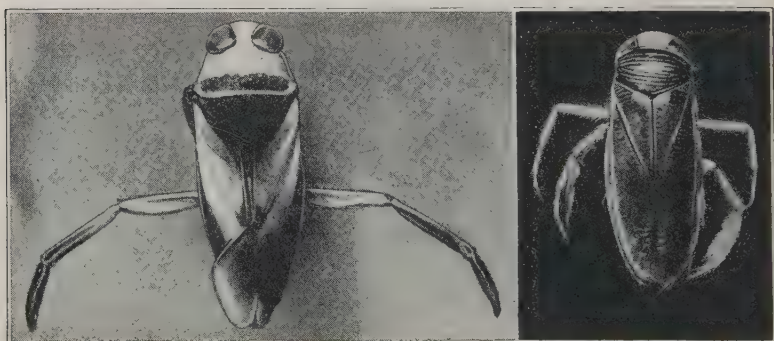


Slightly enlarged

The giant water bug uses its front legs for grasping other insects

The giant water bug is the largest aquatic insect and is found in ponds, swamps, and other quiet water in both the adult and nymphal stages. The front legs are fitted for grasping prey, while the middle and hind legs are flattened and fitted with hairs, thus forming efficient swimming organs. These insects feed upon other insects, snails, and even small fish. The eggs of the giant water bug are attached to reeds above the surface of the water, but in the case of one of the smaller forms, the female deposits the eggs upon the back of the male where they are carried until they hatch.

The adults, in flying from pond to pond, are often attracted to lights and in some localities are known as "electric light bugs."



Four times natural size

Four times natural size

The back swimmer (left) and the water boatman (right) differ greatly in their ways of swimming

WATER BOATMAN AND BACK SWIMMER

Order *Hemiptera*. Families *Corixidae* and *Notonectidae*

HABITAT: In or near ponds, swamps, and other quiet water containing aquatic vegetation throughout the world.

DESCRIPTION: Adult—medium-sized aquatic bugs; front wings thickened at the base with overlapping membranous tips; a short beak under the head; hind legs long, fringed, and well-adapted for swimming. Water boatman with body flattened above. Back swimmer with dorsal surface shaped like the bottom of a boat, making the insect deeper than the water boatman. Nymph—same as adult but with undeveloped wings.

The water boatman and the back swimmer are closely related aquatic bugs which are beautifully adapted to the conditions of their

life. The hind legs are long, oarlike, and fringed with hair, enabling the insects to swim with great agility. All the aquatic bugs (*Hemiptera*) breathe free air, but the water boatmen and the back swimmers can stay under the surface for long periods without coming to the top. At the surface the insect envelops the body with air which shines like silver under the water. Air is also stored beneath the wings in such quantities that if the insect is not vigorously swimming or attached to some object, it will float to the surface.

The water boatman feeds largely upon the ooze at the bottom of the pond, while the back swimmer attacks and sucks the juices of the smaller crustaceans. When handled carelessly, both animals can inflict painful stings with their beaks.

These two insects are readily told apart by their method of swimming. The back swimmer swims on its back, and the water boatman swims in the normal way. The nymphs are found in the water in the same situations as the adults, but the adults use their functional wings in flying from pond to pond. The eggs are usually attached to the stems of aquatic plants, but in some cases are laid inside the stems.

STINKBUG

Order *Hemiptera*. Family *Pentatomidae*

HABITAT: Upon the leaves of trees and small plants all over the world.

DESCRIPTION: Head and thorax form a wide triangle; wings, horny at the base and the membranous tips overlapping; triangular portion between the wings narrowed behind and as long as, or longer than, the distance from its tip to the end of the wings.

These insects are well named because of the extremely disagreeable odor which they emit. They are not the only



Most stinkbugs are plant-feeders

insects which have this odor, however; it is characteristic of some of the stinkbug's relatives, such as the squash bug and bedbug. The odor may be imparted to an object upon which the bug has walked. Many a good-looking berry is thus rendered bad tasting to the person who unwittingly eats it.

Most stinkbugs are plant-feeders, sucking the juices through the stems, leaves, or fruit, but there are some which feed upon other insects, using their sucking mouth parts for extracting the juices of their prey.

ANT LION

Order *Neuroptera*. Family *Myrmeleonidae*

HABITAT: Over the entire United States and southern Canada, as well as the tropics and temperate regions of the world, in dry sand in sand dunes, on lake or ocean shores beyond the action of waves, under overhanging cliffs, under the eaves of dwellings, etc.

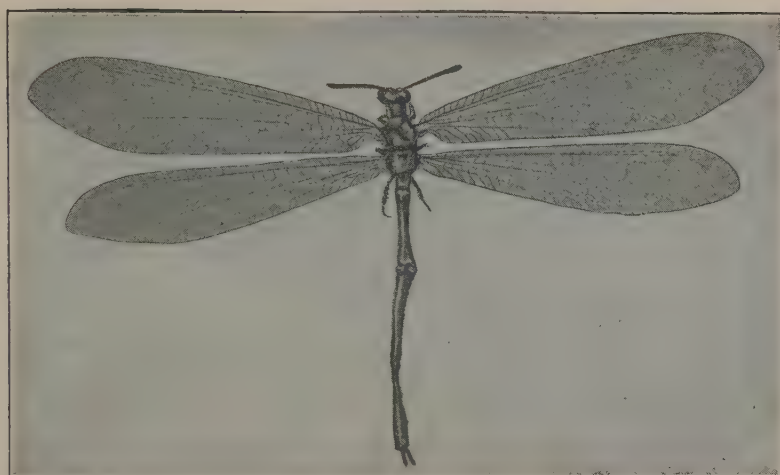
DESCRIPTION: Adult—wings about equal in size; long, delicate, with a great many cross veins. Abdomen slender, and about twice as long as head and thorax. Antennae enlarged at tip, and a little shorter than head and thorax.

Pupa—in round cocoon of sand and silk.

Larva—mandibles long and toothed; abdomen thick, tapering toward the tip.

In dry sandy places one often finds conical depressions in the sand where, concealed at the bottom with only the jaws protruding, the ant lion larva awaits its prey. The luckless ant, venturing too close to the edge of the pit, finds the sand giving way beneath its feet, causing it to slide down the slope into the jaws of the hungry ant lion. When the victim is sucked dry, it is tossed out, and the pit is reconstructed.

The eggs are laid in the sand. Soon after hatching, the larva constructs the pit which serves as a trap for its prey. The larva, pushing backward with the tip of its abdomen, almost disappears beneath the sand, and the grains which fall upon its head are thrown into the air by a quick jerk of the head. By flicking the sand and backing in an ever-decreasing circle, the pit is rapidly constructed, and the ant lion takes up its position at the bottom. The time that an ant lion can wait for food seems almost incredible.



Twice natural size

The adult ant lion is a beautiful, gauzy-winged fly

Ant lions may be kept in the schoolroom in a dish filled with sand for four months or more without food, and yet they optimistically continue to construct their pits and to spend their days patiently waiting for the ants which never come.

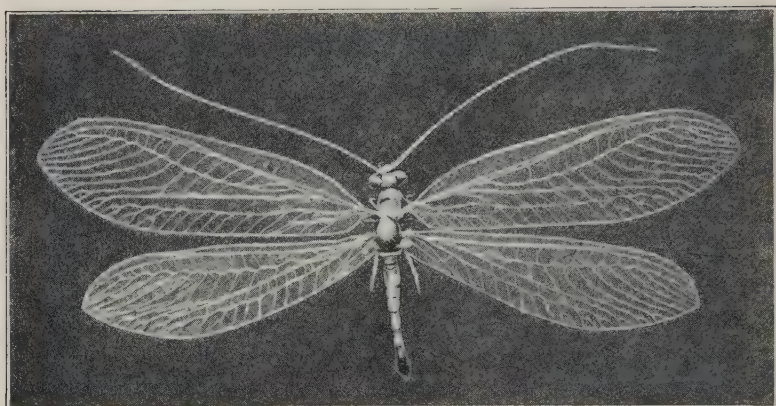
As soon as the larva is full grown, it spins silk from the posterior end. This silk, mixed with sand, is formed into a round cocoon, in which the pupa stage is completed in a few weeks. From this cocoon finally emerges a delicate, graceful, winged insect, totally different in appearance from the voracious larva. The main purpose in life for the adult is to find a mate and insure the perpetuation of the race. It no longer takes food. After mating, the female lays her eggs in the sand and soon dies.

APHIS LION OR LACEWING FLY

Order *Neuroptera*. Family *Chrysopidae*

HABITAT: On trees, bushes, and plants all over the world; the adults often fly to bright lights in the summer.

DESCRIPTION: Adult—wings membranous with many cross veins; antennae very long; most species green in color. Larva—active, spindle-shaped; with well-developed thoracic legs and prominent sucking jaws.



About four times natural size

Most species of the lacewing fly, or adult aphis lion, are green in color

The aphis lion is equal to its relative the ant lion in voracious appetite, but its habits are quite different. On the bark of trees or on leaves covered with aphids one often finds these active insects, with their large jaws and spindle-shaped bodies. They feed largely upon the numerous and rather defenseless aphids, and upon other insects and insect eggs. Therefore, they must be rated as beneficial to mankind.

The aphis lion pupates in a silken cocoon on the lower side of a leaf, and the emerging adult, or lacewing fly, is a beautiful, graceful, delicate green insect with long antennae, which possesses an extremely disagreeable odor.

The adults do not take any food, but mate and lay their eggs. The eggs are remarkable in that they are attached to a long stalk which is composed of a dried fluid secreted by the adult female when she is laying the eggs. Possibly the stalk prevents the larvae from eating up their brothers and sisters when they hatch.

TIGER BEETLE

Order *Coleoptera*. Family *Cicindelidae*

HABITAT: Sandy beaches, clay banks, or roads in hot, fairly dry situations, usually in the open. They occur in the tropics and the north temperate regions.

DESCRIPTION: Adult—usually metallic green or bronze, banded or spotted with yellow. Some are black or without marks;

some living on white sand are a grayish-white color. Prothorax usually as narrow as, or narrower than, the head; mandibles prominent; first abdominal segment separated by the hind legs. Larva—lives in burrows in the ground with a rather neat beveled opening. Jaws prominent; head and thorax with dark shields; abdomen soft with a hump in the middle of the back.

Tiger beetles are the swiftest fliers among the beetles. They offer more sport in the catching than does any other insect. They fly rapidly along the ground in front of the approaching person and alight facing their pursuer. They are off again as soon as the distance becomes too short, and it is usually only after a long chase that they are finally captured. The reward is worth the effort, however, for they are very often of a metallic color or with unique markings on the wing covers, and add much to the appearance of any amateur collection.

The larva makes up for its ugly appearance by its extremely interesting habits. It digs a burrow a foot or more in depth with its mandibles and head, and takes up a position at the top. Here the larva waits until some insect wanders within an inch of it, when it suddenly darts out and snatches the victim down into the lair with its enormous jaws. When the burrow is approached by a person, the larva retires to the bottom until the invader has passed. If a long grass stem is inserted down the burrow, the larva may be persuaded to bite it, and a quick jerk will bring the insect forth.

During the winter the adult hibernates in old logs, etc., and in the spring emerges to lay eggs in the ground and to search for prey.



Three times natural size

The tiger beetle flies more swiftly than any other beetle



Larva enlarged one-third; beetle slightly enlarged

Larva of the water scavenger beetle (left); adult beetle (right)

WATER SCAVENGER BEETLE

Order *Coleoptera*. Family *Hydrophilidae*

HABITAT: Quiet fresh-water ponds and swamps amid aquatic vegetation the world over.

DESCRIPTION: Adult—aquatic beetles with a rather convex upper surface; palpi longer than the antennae; often with a ventral keel. Larva—prominent jaws, with teeth on inner side; antennae shorter than thorax; rarely with gills.

Quiet pools and swamps where aquatic vegetation abounds form the home of the water scavenger beetle. Although commonly thought to live upon the decaying plant material of the pond, these beetles are known to feed upon living insects both in the adult and larval stages. The adult is usually a good swimmer, the middle and hind legs being well adapted to this type of locomotion. Air is carried by the beetle in a film on the underside of the body which gives a silvery sheen.

The eggs are laid in a waterproof case which may be attached to the mother, or to aquatic plants, or may be left to float upon the surface of the water. The larvae have medium-sized jaws and, while not so voracious as the diving beetle larvae, are capable of feeding on large May fly nymphs and other aquatic organisms.

CLICK BEETLE

Order *Coleoptera*. Family *Elateridae*

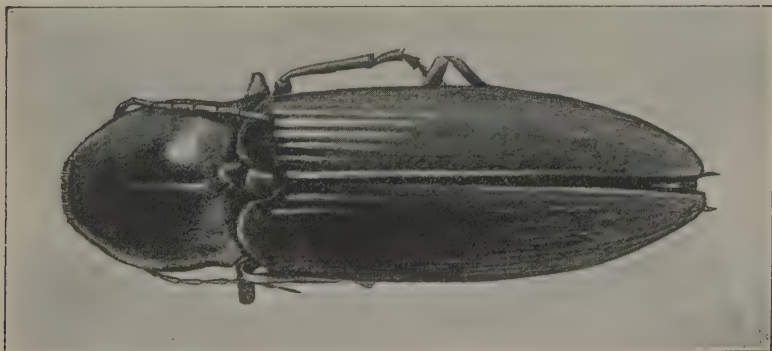
HABITAT: The adults are found upon plants and in dead wood throughout the world; the larvae are found in sod or in dead wood.

DESCRIPTION: Adult—elongated, somewhat flattened beetles tapering at both ends; hind angles of pronotum sharp, and a prothoracic process fitting into a groove on the mesothorax on the underside. Larva—elongated, cylindrical, hard-shelled insects with short thoracic legs and often with a serrated plate on the end of the abdomen.

The click beetle or snapping bug often inadvertently finds its way into the schoolroom, to be used as entertainment when the geography lesson palls. Placed upon its back, the beetle snaps an inch or so into the air through the action of a complicated mechanism in the thorax.

The adults and most of the larvae feed upon plants. In some places, the larvae, which are known as wireworms, feed upon the roots of plants, causing much damage. Many wireworms of various species are found burrowing in the wood of dead trees.

The best-known species is the eyed elater, which possesses two large black spots on the prothorax. These are not eyes, but in the tropics some species have large luminescent organs in the same situation that emit a powerful light as the insect flies through the jungle at night.



Greatly enlarged

The click beetle is the adult of the larva known as the wireworm

*About six times natural size**About two and one-half times natural size*

The whirligig beetle (left) and the diving beetle (right)

WHIRLIGIG BEETLE

Order *Coleoptera*. Family *Gyrinidae*

HABITAT: Adults are found on the surface of quiet fresh water all over the world. The larvae live below the surface of ponds and pools occupied by the adults.

DESCRIPTION: Adult—usually bluish-black beetles with a bronze luster; oval and rather flat in shape, with long front legs and very short middle and hind legs; eyes divided. Larva—elongated, whitish or yellowish, with paired lateral gills on the abdomen. Jaws long and sickle-shaped.

With their incessant gyrations on the surface of the pond or along the border of the stream where the water becomes sluggish, these little beetles have become part of the common knowledge of every country boy. Betwixt two great faunal districts, the air and the water, the anatomy of these beetles has become modified to fit both

situations. The middle and hind legs are short and flattened for swimming, and for diving if pursued from above. Under the hard wing covers are wings for flying from pond to pond. As it is rather necessary for this beetle to see down into the water as well as up into the air, the eyes have become divided so as to function as four eyes, one pair for use under the water, the other for use above the water. Insects entrapped in the surface film are preyed upon.

The eggs are laid upon the leaves of aquatic plants. The larvae live entirely below the surface of the water and are furnished with gills for breathing the dissolved air in the water. The larvae suck the juices of midge larvae and other small aquatic animals, and when ready to pupate, leave the water and spin a cocoon attached to some object near the water. The adults pass the winter hibernating in the mud.

DIVING BEETLE

Order *Coleoptera*. Family *Dytiscidae*

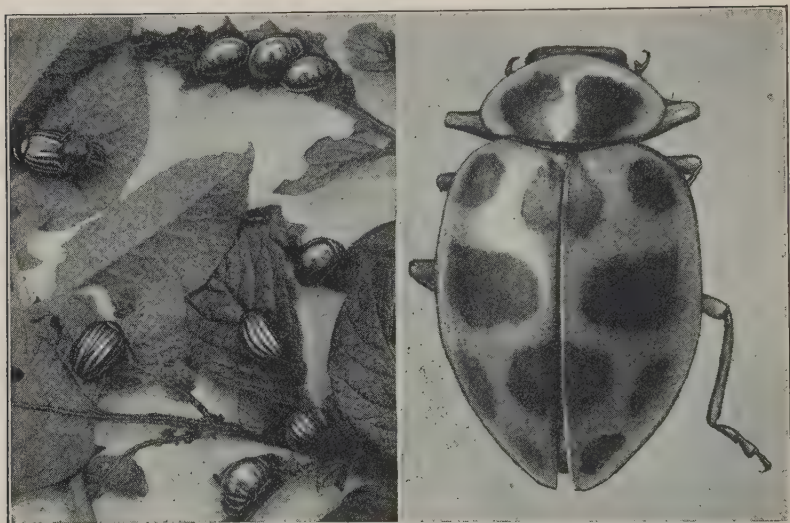
HABITAT: Quiet fresh-water ponds and swamps the world over.

They may be found in situations lacking aquatic vegetation.

DESCRIPTION: Adult—aquatic beetles with rather flattened upper surface; antennae conspicuous and threadlike; hind legs far from middle legs. Larva—prominent, untoothed jaws; no claws at the end of the abdomen.

The diving beetles are the most numerous of the aquatic beetles and swarm in every pond or pool, where they constitute the most important of all the carnivorous insect groups. Their hind legs are beautifully adapted for swimming and enable the insects to swim with even more alacrity than the water scavenger beetles. The air is carried beneath the wing covers in a cavity which is filled at the surface by protruding the posterior end of the abdomen through the surface film and slightly raising the wing covers. A bubble of air usually clings to the posterior end as the beetle descends. When taken from the water, these beetles sometimes make a rather pitiful little squeak which seems to signify distress. Both adults and larvae feed upon live aquatic animals, sometimes even attacking small fish. In an aquarium, they will feed upon any kind of meat.

The eggs are deposited in plant tissues, and the larvae, upon hatching, are so voracious that they have been called water tigers. The pupa stage is passed in a cell in the ground near the water.



Potato bugs and larvae (left); ladybird beetle, greatly enlarged (right)

POTATO BUG

Order *Coleoptera*. Family *Chrysomelidae*

HABITAT: On potato plants in North America and Europe.

DESCRIPTION: An oval, medium-sized beetle with four long dark stripes on each wing cover.

Nearly all of the insect pests that cause such terrific losses on our farms have been introduced from some foreign country and obtained a secure foothold because their normal enemies have not followed them to the new environment. The Colorado potato bug is an exception to this rule. It originally lived upon the sand bur at the foot of the Rocky Mountains, but learned to like the introduced potato of the white man and spread rapidly throughout the country and across the ocean to Europe.

Both the adult beetles and the larvae feed upon the leaves of the potato plant. The eggs are laid upon the undersurface of the leaves when the adults, which pass the winter in the ground, emerge in the spring. When the larvae are full grown, they drop off the plant and pupate in the ground.

Paris green sprayed upon the plants is the best means of controlling this pest.

LADYBUG OR LADYBIRD BEETLE

Order *Coleoptera*. Family *Coccinellidae*

HABITAT: On the leaves and stems of plants all over the world.

DESCRIPTION: Hemispherical beetles with a red or yellow color and usually covered with dark or light spots or marks on the wings; tarsi with three segments.

These little hemispherical beetles are great benefiteurs of mankind because of their predacious activities in both the adult and larval stages. The larvae run about on the bark or leaves of plants, feeding largely upon small insects or insect eggs. They are particularly fond of aphids and scale insects, and in some places are raised artificially and disbursed in orchards that are attacked by these pests.

Two herbivorous species, the squash ladybird and the bean ladybug, are found in the East. They feed upon the plants after which they are named, and thus must be considered serious pests.

The pupa stage is often passed in rather open situations. The larva fastens itself by its tail to some convenient object, and the pupa issues from the split skin, which is usually not entirely freed from the pupa.

FIREFLY

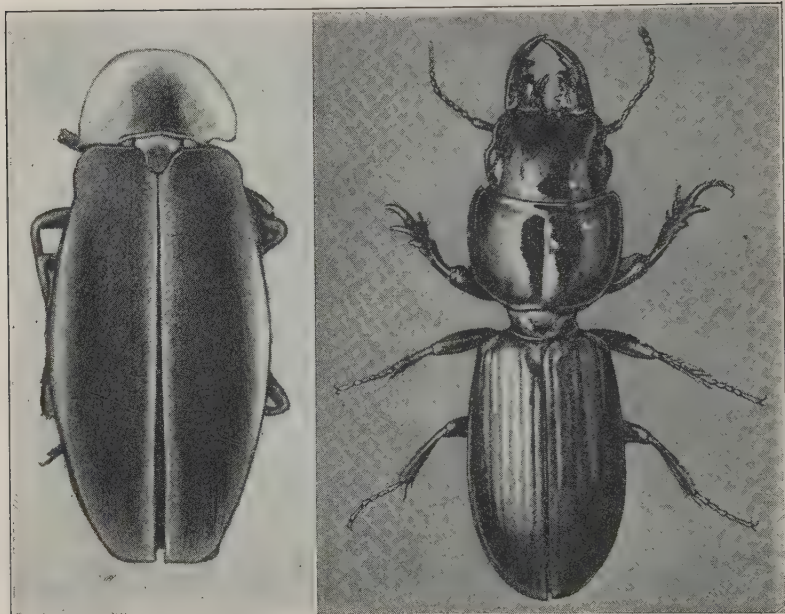
Order *Coleoptera*. Family *Lampyridae*

HABITAT: Found primarily in the fields and meadows of the temperate and tropical regions of the world, but more commonly in the South.

DESCRIPTION: Beetles of medium or small size with soft wing covers, prothorax usually covering the head.

Even the scientist finds it difficult to keep his mind from the thought of fairies when the tiny flashes of the fireflies appear over the fields and meadows during the early summer evenings. The mystery of insect life, however, is often as fascinating as the most imaginative of fairy stories. Fireflies are in reality beetles with soft wing covers which flash their signal for an attraction to the opposite sex. The light organ in most adults is situated on the underside near the end of the abdomen and can be recognized, even in the daytime, by the light color.

The larvae also produce light and are found walking over the

*About four times natural size**About four times natural size*

The firefly (left) and one of the ground beetles (right)

surface of the ground or upon plants at night. They feed largely upon other insects.

The glowworm is the female of a closely related insect which never attains wings and has the appearance of a larva. This insect has light organs situated along the abdomen, giving the appearance of being on fire inside with the light shining out of the cracks and holes.

GROUND BEETLES

Order *Coleoptera*. Family *Carabidae*

HABITAT: Both adults and larvae found the world over, on the ground or in sheltered niches, such as old logs or under stones.

DESCRIPTION: Adult—usually black, but some blue, green, brown, or spotted; legs fitted for running; antennae inserted between the base of the mandibles and the eye, threadlike and tapering toward the tip; first segment of the abdomen on the

underside not extending across the entire abdomen. Larva—generally long with parallel sides; jaws sharp; end of abdomen with a pair of bristly appendages.

These beetles are commonly discovered moving rapidly over the surface of the ground and finding shelter under stones and logs. Nearly all of the ground beetles feed upon live insects, both in the adult and larval stages, and they are most active at night in their search for prey.

One of these insects, the bombardier beetle, ejects a fluid which turns into a puff of penetrating gas, causing considerable surprise to the unwary person who picks one up. It is doubtless an effective method of protection against smaller animals.

Some of the larger ground beetles climb trees in search of caterpillars and are beneficial insects. One species was imported from Europe to help combat the gypsy moth in New England.

CADDIS WORM

Order *Trichoptera*

HABITAT: Shallow fresh-water situations the world over, both in rapid and quiet water.

DESCRIPTION: Adult—small mothlike insects with wings folded rooflike over the body; antennae very long; body covered with hair; mouth parts vestigial.

Pupa—in cocoon or case under the surface of the water.

Larva—cylindrical, caterpillar-like, aquatic insects living in cases or shelter tubes.

The caddis worm is remarkable for its habit of building a case over its body. This case varies considerably among the different species in its shape and in the materials of which it is composed. Species living in rapid water usually build a fixed case of tiny stones and silk span from the mouth. Those living on the sandy bottoms of lakes and pools may build a case of sand particles stuck together with silk, resembling a snail shell in appearance. Other species use sticks or leaves for the case, which is often transported with the insect as it moves from place to place. The net-building caddis worms are among the most interesting forms in rapid water. These larvae build little silken nets above their shelter, facing upstream, and thus catch floating débris for their food.

The larvae feed largely upon aquatic vegetation and débris and

*Twice natural size*

The adult caddis worm is called a caddis fly

do not have to come to the surface for air as they are furnished with gills on the abdomen. They pupate inside the larval cases or in some sheltered spot under the water, being careful to allow for water circulation through their chambers. The adult insects crawl to the surface of the water, where their wings expand.

The adult is called a caddis fly, and its only activity is to mate and lay eggs. Great numbers of caddis flies often come to lights in the summer time. The eggs are laid in or near water and are enclosed in a cement or gluelike substance. The egg masses are often beautifully shaped and are characteristic for the particular species.

PROMETHEA MOTH

Order *Lepidoptera*. Family *Saturniidae*

HABITAT: The larva is found on wild cherry, lilac, ash, and tulip trees, as well as on various fruit trees over the United States and southern Canada. The adults often fly to lights at night.

DESCRIPTION: Adult female—wings light reddish-brown, light transverse line bordered inside with black crossing in the middle; round spot near the outer angle of the front wings.

Adult male—wings blackish, with transverse line and spots faint or wanting; outer margin of fore wings more extended than in the female.

Larva—pale bluish-green; legs and anal shield yellowish; body armed in the middle with black tubercles, on the thorax with red tubercles, and at the rear with yellow tubercles.

The promethea is the best known of all the giant American silk-worm moths. The caterpillar feeds upon the leaves of many fruit and forest trees. It is particularly abundant on wild cherry trees, where the cocoon is found hanging to the twigs in the winter. When the larva is fully grown, it selects a leaf and carefully attaches the petiole to the twig with silk. It then spins a cocoon within the leaf, utilizing the leaf as the outside cover. Attached to the tree in this way, the leaf does not fall to the ground in the autumn, but holds the cocoon in the tree. This seems all the more remarkable when we realize that the larva is hatched in the spring and does not know anything about winter.

It is very easy to collect the cocoons in the winter and allow the adult moth to emerge in the spring in the schoolroom. The cocoon should not be left too long without wetting, however, or the adult may have crippled wings.



About natural size

The male promethea. The male and female of this moth are very different in appearance



The polyphemus moth is brilliantly colored, as described in the text

POLYPHEMUS MOTH

Order *Lepidoptera*. Family *Saturniidae*

HABITAT: In the North American deciduous forests.

DESCRIPTION: Adult—wings yellowish or brownish; gray band on upper border of fore wings; dusky band edged with pink on outer border of both wings; transparent eyespot in each wing crossed by vein and surrounded by yellow and black rings. Larva—light green color, with a diagonal yellow line on each abdominal segment except the first and the last; the last segment has a purplish V-shaped mark.

The wings of the polyphemus moth may expand as much as six inches. This fact, together with the moth's eyespots and striking coloring, brings joy to the proud young collector receiving his first taste of the beauties of nature.

The caterpillar feeds upon the leaves of some of our common forest trees, such as the oak, butternut, basswood, elm, and maple, and is sometimes found on fruit trees. The caterpillars are not common enough, however, ever to cause a great deal of damage to either wild or cultivated trees.

The cocoon is much the same as that described for the luna moth, but is thicker and contains more silk. When the adult is ready to emerge, it secretes a fluid which softens the silk at one end of the cocoon. It then breaks the threads with a pair of spines at the base of the fore wings and crawls out of its tough case.

LUNA MOTH

Order *Lepidoptera*. Family *Saturniidae*

HABITAT: The caterpillar feeds upon hickory, walnut, and other nut trees in the North American forests.

DESCRIPTION: Adult—pale green with a purplish band on the front margin of the fore wings; transparent eyelike spot on each wing; angles of hind wings prolonged into taillike processes. Larva—bluish-green with pearly head; pale yellow stripe on each side of body; transverse yellow line between each two segments on back.

This striking, long-tailed, delicate green moth is as magnificent an insect as occurs in our fauna. These moths are often found clinging to the underside of leaves or flying to lights in summer.

The caterpillar feeds largely upon the nut trees of our forests and spins a thin silk cocoon enclosed in a leaf. The cocoons may be found on the ground under the trees in winter or early spring.



About natural size

The luna moth is a beautiful, delicate green insect

CECROPIA MOTH

Order *Lepidoptera*. Family *Saturniidae*

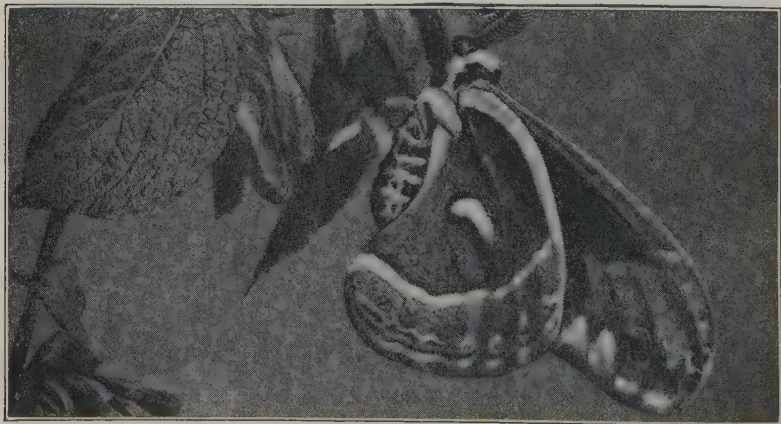
HABITAT: In North America from the Atlantic coast to the Rocky Mountains, feeding upon many varieties of trees and often flying to lights at night.

DESCRIPTION: Adult—dusky brown wings with median white band margined outside with red; red spot near tip outside of zigzag line on fore wing; crescent-shaped white spot bordered with red near center of each wing. Larva—dull bluish-green, body with six rows of tubercles of red, yellow, and blue color armed with black bristles.

The cecropia is the largest of all our giant silkworm moths; the wing expanse sometimes reaches over six inches.

The caterpillar feeds upon more than fifty species of plants, including most of our forest trees and many fruit trees.

The large cocoon is often found attached lengthwise to sticks and twigs near the ground and is composed of a very strong brown silk that is extremely difficult to tear. One end of the cocoon is arranged in such a way that the adult can push out, however, and birds sometimes take advantage of this weak spot to tear open the cocoon and devour the pupa. One is often surprised to raise many parasitic flies from these cocoons instead of moths. The eggs of the parasites are sometimes visible upon the dried skin of the caterpillar.



The cecropia is the largest of all the giant American silkworm moths



About ten times natural size

The ragged wings of the clothes moth are clearly seen when magnified

CLOTHES MOTH

Order *Lepidoptera*. Family *Tineidae*

HABITAT: Attacking woolens in the habitations of men all over the world.

DESCRIPTION: Head clothed with erect, scalelike hairs, antennae shorter than front wings; adults fly away from the light.

To the consternation of every housewife, these tiny moths have forsaken the plant-feeding habits of most of their relatives and find the woolen materials of our clothes, upholstery, and carpets sufficient for all their gastronomic needs.

Always flying away from the light, the clothes moths seek the darkness of closets and deposit their eggs upon the woolen materials. The eggs hatch into little caterpillars which do all the damage by feeding upon the cloth, particularly in places where it is not exposed, spinning silk as they move. They finally spin silken cocoons and change to pupae. The adults emerge in warm weather.

Clothes may best be protected from the ravages of these insects by placing them in cedar chests or tight bags, or by placing them away with an abundance of moth balls or naphthalene flakes. Volatile oils, which can be purchased at drug and hardware stores, can also be sprayed upon the clothes without injury and will kill any eggs or larvae that may exist there.



Comma Butterfly

Male Swallow-Tail

Mourning-Cloak

Viceroy

Great Spangler

Common Wood Nymph

Red Admiral



Hunter's Butterfly

Common Sulphur Butterfly

Red-spotted Purple
Butterfly

Tiger Swallow-Tail

Monarch

American Copper Butterfly

Interrogation Mark

BUTTERFLIES

Order *Lepidoptera*. Superfamily *Papilionidae*

HABITAT: Found flying in fields and meadows in the daytime over the entire world. The caterpillars are leaf-feeders on all varieties of plants.

DESCRIPTION: Antennae not feathery as in the moths, clubbed at the tip, possessing no hook as in most skippers; wings held vertically when at rest, not horizontally as in the moths; pupae not enclosed in a cocoon.

From time immemorial butterflies have attracted the attention of everyone with a keen sense of color. Their gorgeous markings are often the entering wedge to an understanding of the beauty and mystery of the less conspicuous, but often more interesting, forms of insect life.

Butterflies can usually be easily distinguished from the moths and skippers by their clubbed antennae without a hook, by the vertical position of their wings when they are at rest, and by their diurnal habits.

The larvae are seldom hairy, and always feed upon the leaves of plants. The chrysalis is not enclosed in a cocoon, but hangs from a small silken disc and may sometimes also have a silken thread looped around the middle, supporting the insect at an angle.

As the life history of the butterfly is often shorter, particularly in the pupa stage, than the large moths, it offers more satisfactory material for classroom study. The large caterpillar of such a form as the monarch butterfly, found upon milkweed, can be brought into the schoolroom. The chrysalis will emerge from the larval skin before the eyes of the children, and the adult may be seen to emerge and unfold its new wings within a few weeks' time. There is no material that illustrates as well as this the remarkable changes found in insects.

BUMBLEBEE

Order *Hymenoptera*. Family *Bombidae*

HABITAT: Found in fields and on the edge of woods throughout the north temperate region, but rare or absent in some parts of the tropics.

DESCRIPTION: Large, hairy bees usually of black and yellow or black and white color; living in colonies.



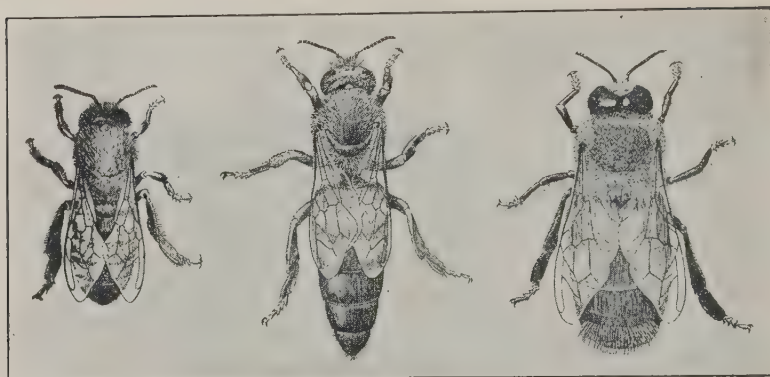
About natural size

The bumblebee is of great importance as a pollen carrier for many wild flowers and farm plants

The burly bumblebees are native to North America and are symbols of a mind-your-own-business attitude. They are stolidly industrious and seldom take offense unless directly attacked. There are many large species with bright yellow and black hairy bodies. Some of the medium-sized species are black and white.

The nest is built by the queen in the ground, where a honey-pot and brood cell are constructed. The first workers relieve the queen of the ordinary duties of the nest in order to release her energies for the more important duty of laying eggs to insure the perpetuation of the race. The workers construct new brood cells and store them with bee bread made of pollen and nectar, upon which the young grubs feed. As soon as the larvae have pupated and emerged, the cells are used for the storage of honey for the use of the adult bees.

In the fall, males and young queens are produced, which leave the colony on a marriage flight. The old queen and the workers die on the approach of winter; the males die after the mating flight. The new queens hibernate in a sheltered place and early in the spring venture forth to start a new colony.



Courtesy, U. S. Dept. of Agriculture.

The honeybee, showing (left to right) worker, queen, and drone

HONEYBEE

Order *Hymenoptera*. Family *Apidae*

HABITAT: Originally from the Indo-Malayan region, the honeybee has been distributed all over the world by man and is found on flowers in every field.

DESCRIPTION: Social bees with the leg consisting of three large segments instead of two; hind tibia without apical spurs.

Although the honeybee does not have the elaborate caste system found among the ants and termites, in some respects it shows the highest degree of social life found among the insects. The queen honeybee never starts a nest by herself, but is accompanied by a host of workers from the parent hive which swarm out when the colony becomes overcrowded. In all other social insects, the reproductive forms start the new nest without the help of the workers. As the queen honeybee never has to take care of herself, she has lost all the baskets, combs, brushes, and pincers that are found on the legs of the workers for manipulating pollen and wax.

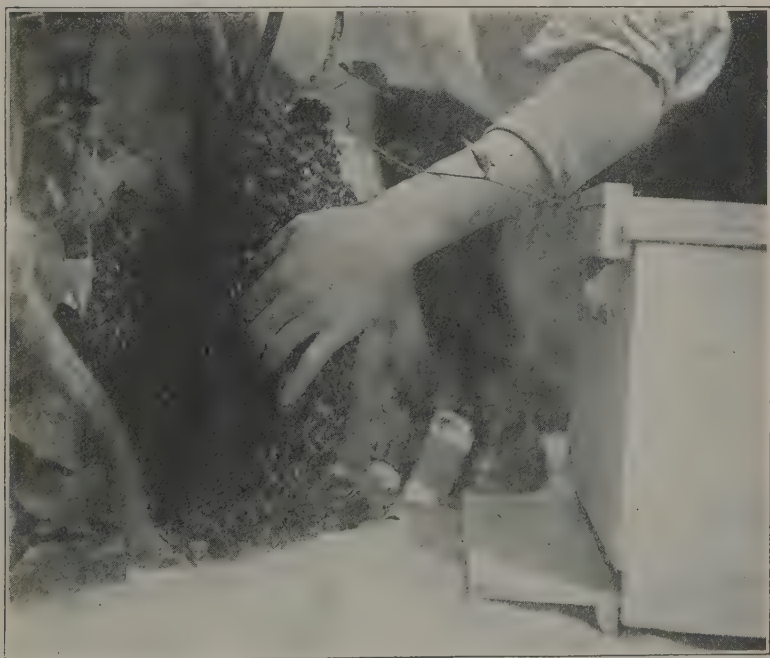
Although the honeybee was originally imported from Europe, it has escaped in such numbers as to become a well-established wild insect of our forests and fields. It nests in hollow trees and suffers depredations from some common wild animals, such as skunks and bears, which seem to be relatively impervious to its stings.

The average healthy colony of honeybees will contain from thirty-five thousand to fifty thousand bees, most of them workers

which do not lay eggs, in spite of their female sex. The workers perform all the labor of the colony, secreting wax and building the comb, feeding and caring for the other castes and the young, collecting pollen and nectar in the field, and protecting the colony from marauders with their stings.

The drones or males are larger than the workers, have much larger eyes, and are only present in the summer during the swarming season. After the young queens have mated during a glorious marriage flight, the drones are driven out or killed, and the militant suffragettes again settle down to the tranquillity of a maleless colony.

The egg-laying queen is larger than the workers and seldom leaves the colony except on the mating flight and during the swarm. Although she possesses a powerful sting, she seldom uses it except when she battles with a rival queen.



Hiving bees with bare hands. Only experienced bee workers should attempt to hive bees in this manner. A safer method is to shake the branch or place it just in front of the hive



About two and one-half times natural size

The digger wasp secures its food by preying upon many kinds of animals

DIGGER WASP

Order *Hymenoptera*. Family *Sphecidae*

HABITAT: In dry sandy regions the world over, particularly abundant in the South.

DESCRIPTION: Winged wasps with wings not folded lengthwise when at rest; hind wings with an anal lobe; abdomen of varying forms.

In hot sandy places, large, medium-sized, and small wasps are often found busily digging holes which usually go down at an angle in the sand. The sand is loosened with the mouth and kicked out with the bristly feet. To these burrows the wasps will carry insects or spiders which have been paralyzed by their sting. In most cases the egg is laid upon the stored insect, the sand filled in, and the young left to feed and care for itself until it is full grown. In other cases, however, the young is fed continuously upon freshly killed flies. Many kinds of animals, such as spiders, cicadas, beetles, cater-

pillars, crickets, roaches, bees, ants, and bugs, are preyed upon by different species of these wasps.

Some related species dig out the pith of plant stems for their nests, and one species is commonly found in the dead branches of sumac, storing the nest with aphids. It is possible to bring this nest into the schoolroom for study.

HORNETS AND YELLOW JACKETS

Order *Hymenoptera*. Family *Vespidae*

HABITAT: Nests in trees, in the ground, and in sheltered places throughout the temperate and tropical regions of the world.

DESCRIPTION: Wasps with comparatively short and stout abdomens attached to the thorax by a very short pedicel. Wings folded lengthwise when at rest.

The social life of these wasps makes possible large nests and communal organization not found among their solitary relatives. The colony is composed of three kinds of individuals, the egg-laying queen, the sterile workers that are usually somewhat smaller than



Three times natural size

The hornet is usually black and white in color



Nest of the yellow jacket. Yellow jackets sometimes build their nests in trees, like the hornets, but more often construct them in the ground

the queen, and the males that are produced late in the season. The queen constructs the nest in the spring and feeds the larvae upon insects. Later, the larvae develop into workers which enlarge the nest and take care of the young.

In temperate regions the males and young queens develop in the fall and swarm forth on a mating flight which ends in the death of the male. The workers die with the approach of winter, and the queen hibernates in some sheltered place until warm weather, when she starts a new nest.

The yellow and black species, commonly known as yellow jackets, usually construct their nests in the ground. The nests are built of paper in a hollowed cavity. The hornets, which are usually black and white, build their nests of paper in trees or under the eaves of buildings. The paper is made of chewed wood cemented together with saliva. The interior of the nest is composed of layers of cells where the larvae are raised.

In some cases the queen of a parasitic wasp will invade the nest and lay her eggs in the cells. The larvae will be taken care of by the host wasp, never suspecting that it is not feeding its own young.



The mud dauber builds its nest, cell by cell, of pellets of mud

MUD DAUBER

Order *Hymenoptera*. Family *Sphecidae*

HABITAT: The nests are found in sheltered places such as overhanging cliffs, under the roofs of sheds, houses, etc., all over the world.

DESCRIPTION: Wasps with the petiole of the abdomen long and thin, ending abruptly at the enlarged posterior segments. Wings not folded when at rest.

On the rafters in attics of houses or in sheds are often found the mud nests of these thread-waisted wasps. The nests may also be found under flat stones or on sheltered cliffs. The wasp collects mud from the edges of pools and takes a pellet to the nest, working it in with its mandibles. Gradually a cell is constructed, which is filled with spiders that the wasp has paralyzed with its sting. Upon these spiders an egg is laid and the cell is sealed up with mud. Other cells are then attached, stored with spiders, and sealed with the egg inside. The tiny grub hatching from the egg feeds upon the spiders until full grown, when it spins a cocoon in the cell and transforms into a pupa. The emerging adult digs itself out with its mandibles.

ICHNEUMON FLY

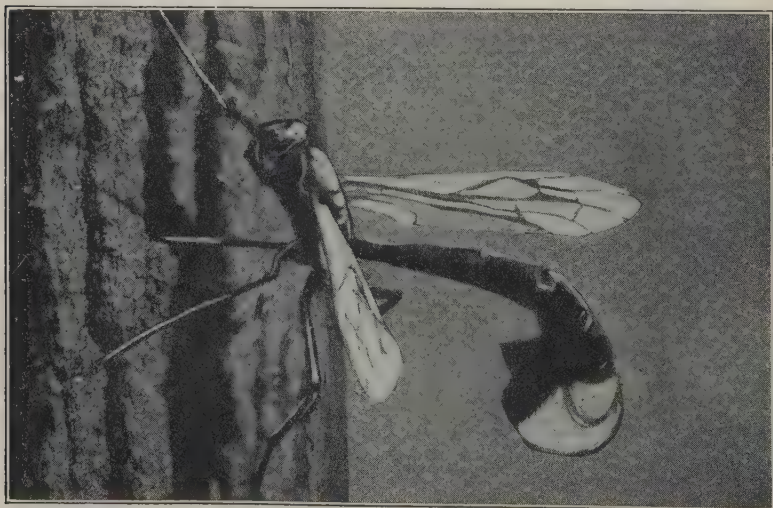
Order *Hymenoptera*. Family *Ichneumonidae*

HABITAT: Parasitizing insects, particularly caterpillars, all over the world.

DESCRIPTION: Wasplike insects with constricted abdomen, membranous venter (often with longitudinal fold); hind wings without anal lobe; trochanter two-jointed.

Parasites of any sort usually fill us with a feeling akin to disgust, but when the parasite attacks insects which cause man great economic losses, we must be thankful. Actually parasitism is just as much a part of nature and as essential to the balance of life as are the predacious activities of many animals, including man.

The ichneumon fly is the largest of the insect parasites and confines its attention entirely to other insects. It seeks out its prey, usually caterpillars, and lays one or more eggs in the tissues of the victim. The larvae hatching from these eggs eat the tissues of the host but seldom cause the death of the victim until after it has spun its cocoon. Most ichneumon flies pupate in the host tissues. A closely related group, the braconid flies, burrow through the skin and spin little cocoons on the back of the caterpillar.



Slightly enlarged

An ichneumon fly driving its four-inch-long drill into hard wood



Photograph by J. G. Hubbard and O. S. Strong

Courtesy, The Columbia University Press

A mixed colony of worker ants, which shows the relative sizes of workers in different species

ANTS

Order *Hymenoptera*. Family *Formicidae*

HABITAT: Found in every terrestrial situation inhabited by animals over the entire world.

DESCRIPTION: Ants are unique in possessing one or two lens-shaped knots between the thorax and gaster.

Practically all of the myriads of insects that fall to the ground to die after their brief span of life are found by the wandering members of some ant colony and are either eaten on the spot or dragged off to the burrow to be fed to the young. Many ants do not wait for their prey to die, but actively hunt live insects. Others seek any sweet substance such as the nectar of flowers, honeydew secreted by aphids, or sugar in our pantries.

The ants have been studied by man since the days of Solomon because of their remarkable social existence, which has rendered them the dominant insect in a world dominated by insects. Ants lived in highly organized societies long before man appeared on the face of the earth and may still exist long after man has disappeared.

All ant colonies are composed of at least two types of individuals. The egg-laying queen usually can be recognized by the frayed edges

of the base of the wings which are chewed or rubbed off when she descends to the ground after the mating flight. The worker is a sterile, wingless female, smaller than the queen, and makes up the bulk of the colony. Winged males and young winged females may be found in colonies at certain times in the year. These function in the starting of new colonies. In some ant colonies the workers are of several sizes. Sometimes the larger workers are so highly modified for defense that they are called soldiers, and they may give up entirely the normal nutritive function of the other workers.

The division of labor is very elaborate among many ants and too complicated to mention in a short survey of their life. Suffice it to say that there are slave-making species that rob other nests of their young and bring them up to do the work of the marauders; honey ants that possess workers who fill their abdomens so full of honey that they become nothing but animated jars; leaf-cutting ants that chew up collected leaves into a paste upon which they grow fungi for food, and army ants that travel in huge armies over the surface of the ground in search of insect prey.

Most ants excavate their nests in the ground or under stones, but some nest in rotten logs or, as in the case of carpenter ants, may even dig out elaborate galleries in hard wood. In the nests the workers care for the young wormlike grubs and the cocoons, which are often mistaken for eggs.

HOUSE FLY

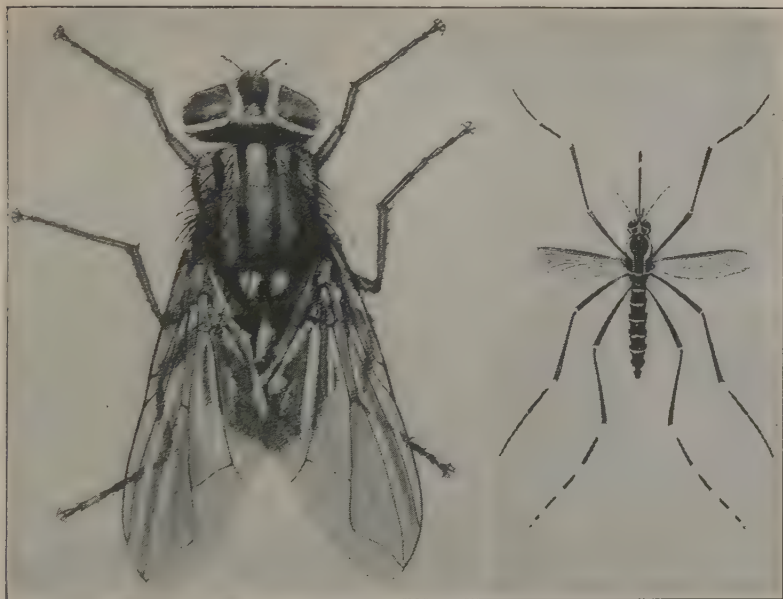
Order *Diptera*. Family *Muscidae*

HABITAT: In the vicinity of houses all over the world.

DESCRIPTION: Two-winged flies with the veins of the wing almost meeting near the tip; the bristle of the antennae covered with hair all the way to the tip.

Wherever man occurs on the earth, there will be found this camp follower who, uninvited, helps himself to a portion of our meal and adds insult to injury by tickling our noses when we try to doze in the afternoon. We have recently discovered that the house fly carries many disease germs mechanically on its legs and is therefore a dangerous inhabitant of our houses.

The eggs are laid in refuse such as manure piles, garbage, and decaying animal matter. The young flies or maggots always crawl away from light and are without head, legs, wings, or mouth parts.



The house fly and the female mosquito, greatly enlarged

These organs, so essential to the adult fly, are formed within pockets which turn inside out when the maggot pupates. The pupa stage is passed within the hardened last larval skin. The whole life history takes from fourteen to forty days, depending upon the temperature.

House flies are most easily eradicated by controlling their breeding-places. Garbage should always be placed in a covered pail and should be removed often. Manure piles should be sprinkled with powdered borax and water.

MOSQUITO

Order *Diptera*. Family *Culicidae*

HABITAT: Mosquito larvae may be found all over the world in any standing fresh water; thus tin cans, rain barrels, and cisterns often become their breeding-places.

DESCRIPTION: Adult—readily distinguished from mosquito-like flies by the fringe of scalelike hairs on the margin and veins of the wing and by the long sucking proboscis.

Pupa—head and thorax enlarged and not distinctly separated. Abdomen slender and movable.

Larva—head and thorax wide in comparison with the slender abdomen, which usually bears a long breathing tube on the eighth segment.

Our irritation at the persistent attacks made upon us by mosquitoes often causes us to lose sight of the drama of their life. Little would we dream that the little larvae or “wigglers” we see in a rain barrel wriggling through the water, feeding upon débris, and occasionally thrusting the tube near the end of the abdomen through the surface film for air, were simply the younger stages of the annoying mosquitoes. The pupae are found in the same situations as the larvae. They are remarkable for their activity, although they take no food. Strangely enough, in the pupa there are two breathing tubes located on the thorax, instead of the single abdominal tube found in the larva.

When the adult is ready to emerge from the pupa skin, the pupa floats to the surface, the skin splits, and the winged mosquito issues forth. Only the female sucks the blood of animals. All mosquitoes do not have this habit, some feeding upon the juices of plants. The eggs of our common mosquito are laid in the form of a little raft, which floats upon the surface of the water.

In some regions mosquitoes carry the dreaded diseases of malaria and yellow fever and are often killed by pouring oil on the ponds inhabited by the larvae.

MIDGE

Order *Diptera*. Family *Chironomidae*

HABITAT: In or near fresh-water situations the world over. A few species live in manure or in decaying vegetable matter on land.

DESCRIPTION: Adult—small mosquito-like flies with two wings and often with feathery antennae. The wings are not fringed with scalelike hairs as in the case of the mosquito. Larva—elongated, cylindrical, wormlike, aquatic; very small, with fleshy appendages in back of the head and on the posterior end. Many are red in color.

The adult midge is often mistaken for a mosquito, but in most cases does not suck the blood of animals. One group, however, the

sand flies or punkies, are extremely bothersome, quite out of proportion to their size. These minute insects, smaller than the head of a pin, literally seem to bury their heads into the skin when they bite.

Most of the larvae are aquatic and often live in tiny tubes on the surfaces of stones or on aquatic vegetation. The tubes are built of sand, mud, or pieces of plant material. Midge larvae are so tiny that they are often overlooked in pond study. If aquatic plant material is dropped into a dish of water, however, a few of the small larvae are almost



Seven times natural size

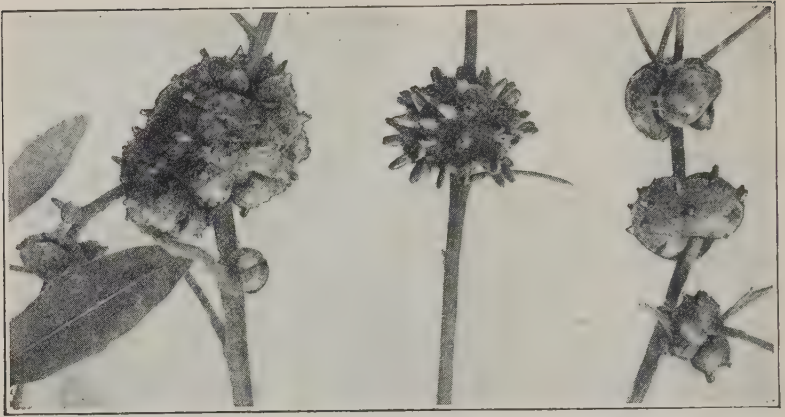
The feathery antennae of the midge are unlike those of the mosquito

sure to be found near the edge, swimming in their characteristic figure 8 loops. Some of the larvae are red in color and are called bloodworms. The larvae as a rule feed upon minute plant debris or diatoms in the water and form an important food for many of the higher water animals. The pupa is often active and when mature floats to the surface, where the skin splits and the adult emerges.

GALLS

Swellings of various sorts, which are usually taken for the stings of insects, are often noticed upon plants. If the swelling is carefully opened, however, the causative agent will usually be discovered in its little house, surrounded by delicious plant food and well protected from the outside world.

Many insects and some mites stimulate the plants to form galls which are very diverse in their shape, size, and armature, and may be quite different on the same plant. Some are open, either above or below, and form little pockets on leaves or stems. These are usually caused by aphids. Some



Horned oak galls on pin oak

are closed and may be formed on leaves or stems, particularly on the oak tree. These are caused by tiny gall wasps and may be smooth, spiny, or mossy, or in some cases formed into a large round ball with a fuzzy layer between the outside and the tiny hard nucleus. The last-named kind is referred to as an oak apple and is formed from a young oak leaf. In some cases the stems of plants like the goldenrod and aster have swellings which are caused either by fly larvae or caterpillars.

In practically all forms, the stimulus causing the plant to develop these extraordinary growths is a secretion from the young insect, together with the mechanical action of the mouth parts.

A collection of galls makes an interesting winter study for the schoolroom.

Alfred Emerson

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REPTILES AND AMPHIBIANS

THIS group of animals includes the cold-blooded creatures with backbones, exclusive of the fishes. "Cold-blooded" means that the temperature of the individual is approximately that of the environment in which it is found. This is, of course, quite different from the condition which is found in the other backboned animals, such as the birds and the mammals. There are no poisonous amphibians, though some excrete juices from their skins which are unpleasant to the taste of their enemies. There are a number of reptiles that are poisonous. In earlier times in the history of the earth, the individuals of the reptiles and amphibians were, in some cases at least, much larger than those found on the earth today. For example, the giant dinosaurs of which we hear so much were reptiles.

REPTILES

The group of animals known as reptiles includes species of great economic importance and others which may be a menace to man's life. It includes creatures weighing hundreds of pounds and others weighing an ounce or so. It includes creatures which feed on living plants and animals and those which feed on dead material; creatures which lay eggs and others which produce living young; creatures which are sluggish and creatures which are most active.

With all these differences the reptiles have a few things in common. They are all cold-blooded animals; their bodies are generally scale-covered, and if they have limbs and fingers and toes, these fingers and toes are generally supplied with claws.

The reptiles generally are divided into the snakes, lizards, and turtles. In addition to these groups, each of which has a

large number of species, there is the smaller group known as the crocodilians, including alligators and crocodiles. Both alligators and crocodiles are found in the Americas, though probably to a decreasing extent. Alligators reproduce by laying eggs in nests of decaying plant material. The young that hatch from the eggs are left to shift for themselves, entirely independent of parental care in spite of what we may read at times in popular nature literature. In fact, parental care, as such, has little or no development among the reptiles.

The number of reptiles now in existence is probably very much smaller than it was in ancient times, and it is certain that the individuals living in the present day are much smaller in size than were their ancestors.

SNAKES

There is probably no group of animals in which all members suffer more for the bad repute of a few than the group to which the snakes belong. It is true that the penalty of mistaking a dangerous snake for a harmless one is often very heavy, but there is so much good done by the vast majority of snakes that we owe it to ourselves to be able to react with reason to any snake we may find.

From an academic standpoint we can safely say that there are few groups of animals that offer a greater variation in types of reproduction and of food habits in proportion to the number of species than do snakes. It is true that all have essentially the same type of locomotion. It is true that all feed upon living animals which are swallowed whole, but some secure these animals almost exclusively in and about water, some secure them on the ground, and some secure them in the shrubs and trees above ground. The manner of killing the prey varies from swallowing the creature alive and letting it die afterward to killing it by constriction or by the injection of poisons. Practically all snakes have marvelous ability to expand their jaws and swallow a food mass whose



An African python which has just swallowed an antelope

body diameter may be greater than that of the snake itself. The kind of animals eaten is frequently somewhat restricted in a given kind of snake and this gives us the key to determining whether or not the snake is useful to man. The worst enemies of some poisonous snakes may be certain nonpoisonous snakes, for example, so that man cannot with justice declare war on all snakes.

After a period of feasting and growth, snakes may change their skins. At such times they may be sluggish or, on the other hand, they may strike blindly in any direction. The reason for this apparent lack of a sense of direction lies in the fact that the snakes cannot see well at this time, the scales over their eyes becoming clouded. The tongue may serve as a sensory organ at all times and is not used as a "stinger" as many people seem to think. Generally the tongue can be protruded through a slit in the front of the mouth without the snake's opening its mouth. When the skin is shed, it may be shed completely or, as in the case of the rattlesnakes, it may be shed except for the scale at the end of the tail. Each rattle section on a rattlesnake may be taken as an indication of the fact that it is a relic of a shed skin, so that the number of rattles indicates that the skin has been shed at least that number of times. This has no

relation to the number of years the snake may have lived, and, since some of the end rattles may be eventually shaken off, it does not always indicate the total number of times the skin has been shed. Snakes are not provided with stingers in the ends of their tails, in spite of popular belief to the contrary.

The snakes of temperate zones dangerous to man are those that inject poisons into their victims most commonly through hinged, perforated fangs that pierce the skin of the victim and leave the poison in the blood. Fortunately in the North Temperate Zone in America the snakes of this type are comparatively few in number and may be identified with reasonable ease. The dangerous snakes in this zone include the rattlesnakes, the cottonmouth moccasins, the copperheads, and the coral snakes. Practically none of these snakes is found in any place in Canada except possibly the rattlesnakes, which are easily identified by the presence of rattles. The copperheads range nearly to the northern border of the United States and the cottonmouth moccasins range farther south. The coral snakes are related to the cobra, do not range north or east of the southwestern United States, and resemble the king snakes or milk snakes somewhat in body markings. The red and black markings on the backs of the harmless king snakes are adjacent to each other, while this is not the case in the coral snakes. The fangs of coral snakes are not elaborate, but the poison attacks the nerves of the victim.

From the standpoint of reproduction, snakes may lay eggs or may give birth to living young. Those that give birth to living young may be responsible for the belief that snakes can swallow their young. There is no doubt but that they can do so, but the act would result in the young's becoming digested rather than saved. Among the snakes described, the green snakes, ring-necked snakes, hog-nosed snakes, black snakes, and the milk snakes lay eggs, while the water snakes, garter snakes, copperheads, water moccasins, and rattlesnakes give birth to living young.

RING-NECKED SNAKES

Diadophis

SIZE: Slender snakes from 1 to 2 feet long.

RANGE: Northern United States from coast to coast, Central states, and along the Mexican border.

There are many species of ring-necked snakes in the United States. Generally they are gentle little snakes that make attractive pets and feed upon earthworms, other snakes, small salamanders, and other cold-blooded animals, such as lizards. They have dark gray to black backs and yellow, orange, or reddish bellies, sometimes spotted with black. Around the neck is a narrow ring. The eggs are laid usually in early summer and are from one to one and one-half inches long and about one-third that diameter. They are laid in damp spots, usually covered, and hatch in about six weeks. The species in the eastern United States is *Diadophis punctatus*. The Pacific coast species is *Diadophis amabilis*. Each of these species has the scales in fifteen rows. The species of the central states is *Diadophis arnyi* and the species which is found along the Mexican border is *Diadophis regalis*. Each of these two last-named species has scales in seventeen rows.



The numerous species of the ring-necked snake are well known in the United States

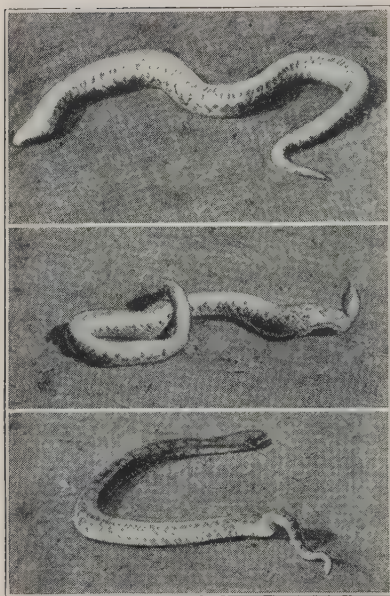
HOG-NOSED SNAKES

Heterodon

SIZE: Rather stout snakes, 15 to 24 inches in length.

RANGE: In the Great Basin of North America and the eastern United States.

The "spreading vipers" or "hissing vipers" that one hears so much about are hog-nosed snakes. They are perfectly harmless



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Photographs by A. B. Klotz

The upper pictures show a hog-nosed snake feigning death. The lower shows the same spreading viper turned over on its stomach and attempting to escape

and the most shameless bluffers. They will even feign death, lying on their backs with their mouths open. Sometimes you can turn an apparently dead hog-nosed snake over on his stomach and then he will turn over on his back to make you believe that he is dead after all. The pictures show a hog-nosed snake reversing this order and attempting to escape. The most conspicuous characteristic, in addition to its habits, is the nose so well described in its name.

Hog-nosed snakes are found in the United States east of Montana and Arizona and into northern Mexico. They lay eggs and feed for the most part on frogs and toads. This habit, of course, does not improve their economic value.

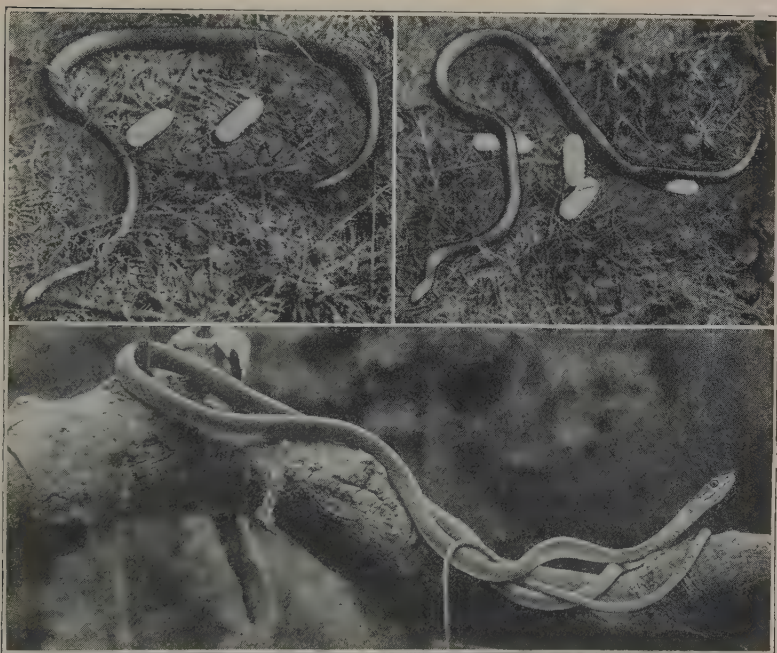
The species of the Great Basin and of the eastern states is *Heterodon contortrix*. The color of this snake is red or brown with about twenty-eight dark or black patches from the head to the tail, alternating with a series of irregular dark patches on the sides. The belly is yellowish with black blotches at the edges. These snakes have twenty-three to twenty-five rows of scales.

GREEN SNAKES

SIZE: Smooth green snake, 12 to 16 inches long; rough green snake, about 30 inches long. Head, small in both species.

RANGE: From New Mexico north through the middle states to southern Canada and east to the Atlantic.

Smooth green snakes are the gentlest of snakes and among the most useful, since they feed largely upon insects. They are uni-



Upper photographs by A. B. Klotz; lower, by Raymond L. Ditmars

The two pictures above show a smooth green snake laying eggs. The one below shows the rough green snake, which is about twice as long as the smooth

formly green but are lighter colored beneath. They have smooth scales in fifteen rows. The smooth green snakes are to be found on the ground like the others described on the foregoing pages. They lay eggs as is shown in the upper pictures, one of which shows the part of the body which contains the eggs conspicuously swollen, while the other shows an egg almost ready to be freed from the body.

The rough green snake differs from the smooth green snake more in the nature of its scales than in any other respect. The scales are keeled, in seventeen rows. In this snake the belly is yellow. Scientific name of the smooth green snake, *Liopeltis vernalis*; of the rough green snake, *Opheodrys aestivus*.

It is interesting to know that when green snakes are preserved in some of the ordinary preservatives used in laboratories, they frequently turn to an attractive shade of blue.

BLACK SNAKES

Coluber

SIZE: 5 to 7 feet in length; body, slender.

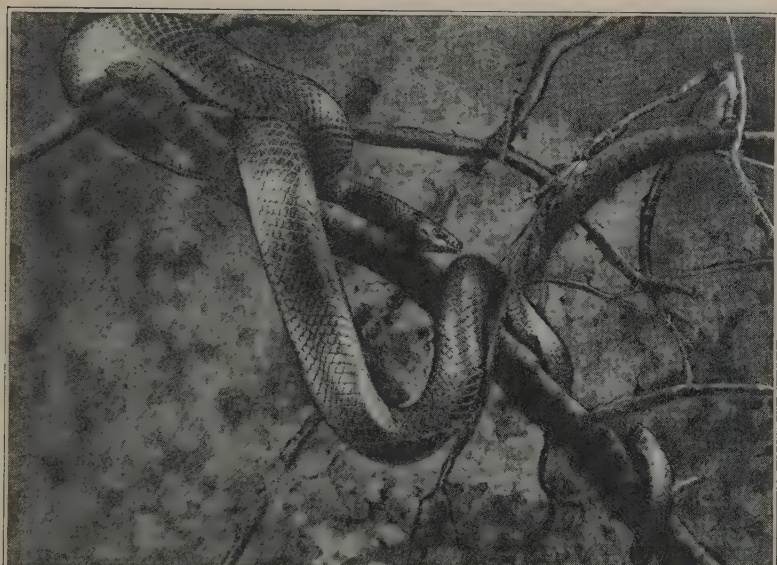
RANGE: Many species in the New and Old worlds.

Black snakes belong to the same genus as the coachwhip snake and are closely related in habits and other respects to the pilot black snake, the fox snake, the chicken snake, the corn snake, and the gopher, or indigo, snake. They are distantly related to the bull snake and the pine snake. Black snakes are generally black above and black to gray or yellow beneath. They have smooth scales in fifteen to seventeen rows. The young snakes are gray with dorsal transverse bars and lateral spots. The head in these snakes is separated from the body by a distinct neck. The black snakes and their kin feed to a great extent upon warm-blooded animals such as rodents and birds, though they will also eat other snakes readily. Black snakes are most frequently found hunting in the trees or bushes through whose tops they can travel with amazing speed.

The pilot black snake which ranges from Massachusetts to the Gulf and west to Texas and Illinois, the chicken snake of the South, the corn snake of the South, and the fox snake of the Middle West, all relatives of the black snake, range in length from one and one-half to eight feet. They have flat blunt heads and scales rough on the back and smooth on the sides, in twenty-five to twenty-nine rows. In color they vary from yellow to light brown and from gray to yellowish- or reddish-brown. The chicken snake is striped, while the others are uniform in color or spotted. Scientific name of the pilot black snake, *Elaphe obsoleta*; of the chicken snake, *Elaphe quadrivittata*; of the corn snake, *Elaphe guttata*; of the fox snake, *Elaphe vulpina*.

The gopher, or indigo, snake, another relative of the black snake, is one of the largest of these snakes, sometimes reaching a length of eight feet. It is shiny black with smooth scales in seventeen rows. It is often found around barns and houses looking for rats and mice, and ranges from the Gulf states northward into South Carolina and westward to Texas. Scientific name of the gopher, or indigo, snake, *Drymarchon corais*.

The bull snake, found in the dry woods in the United States, and the pine snake, which ranges from southern New Jersey to the Gulf



Lower photograph by Elwin R. Sanborn Courtesy, The New York Zoological Society, New York City

The top photograph shows the black snake in its characteristic habitat, a tree top. Below is the fox snake. Compare the well-developed head and distinct neck of the black snake with the flat, blunt head of the fox snake

and is often abundant in pine woods, are about five feet in length with scales rough on the back and smooth on the sides in twenty-five to thirty-five rows. These snakes have long and pointed heads. They are reddish-yellow to yellowish-brown, marked with spots of darker color, and with white to yellowish bellies. They belong to the genus *Pituophis*.



Left photograph by N. G. Bump

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At the left is a milk snake just emerging from its egg. The milk snake is a most useful, harmless species. At the right is its close relative, the king snake, which destroys great numbers of rattlesnakes

MILK SNAKES AND KING SNAKES

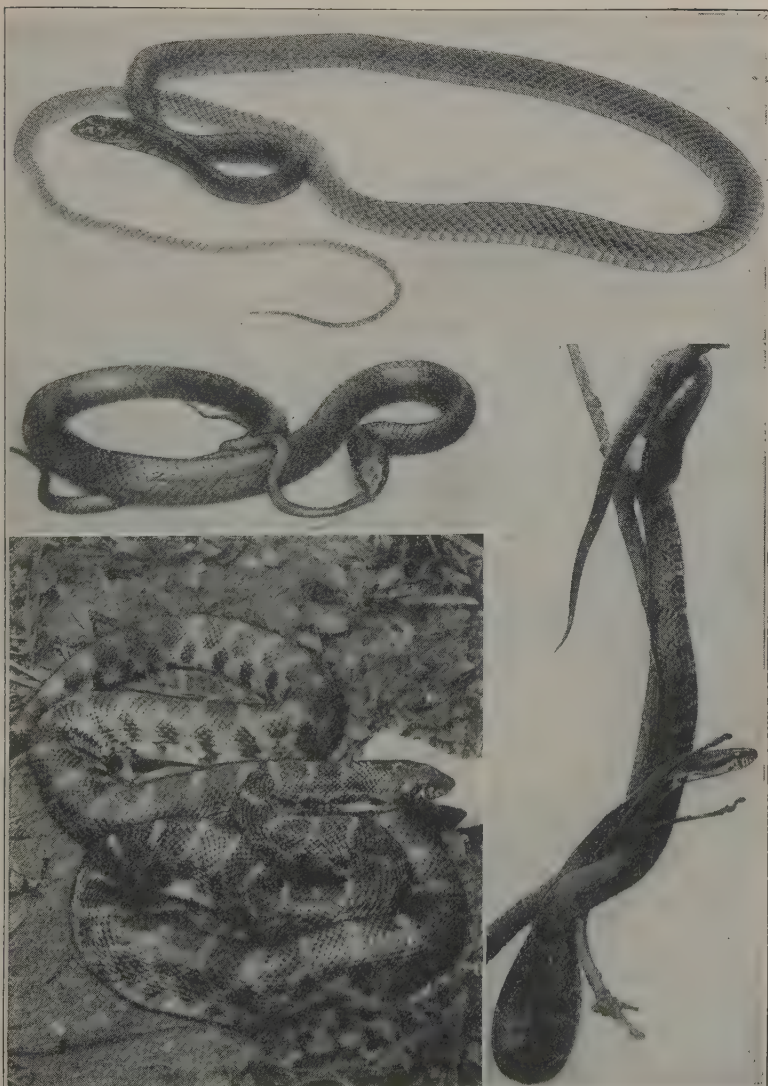
Lampropeltis

SIZE: 2 to 5 feet long.

RANGE: California to New England and south to the Gulf and into Mexico.

Among the most useful snakes as destroyers of rodents and of other snakes are the milk snakes. They are closely related to the king snakes which belong to the same genus and are great destroyers of rattlesnakes. Milk snakes have been maligned as milkers of cows. They could not do this if they wished and could not hold enough milk to do any damage if they did. In both the milk snakes and the king snakes the head is rather distinct from the body. The scales are smooth and in from nineteen to twenty-seven rows.

The milk snake is pale in color with large red, chestnut, or brown bands bordered with black. The belly is yellowish or red with black spots alternating irregularly with the dark bands above. The king snake is black with narrow transverse color bands. The scarlet king snake has a ground color of yellow with bright red bands nearly encircling the body. The coral king snake has a ground color

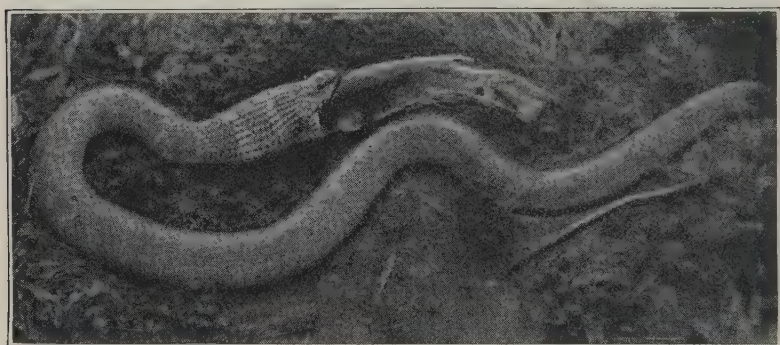


Upper, center, and lower right photographs by Elwin R. Sanborn
 Courtesy, The New York Zoological Society, New York City
 Lower left photograph from Bulletin No. 239, "The Snakes of Iowa"
 Courtesy, Agricultural Experiment Station, Iowa State College of Agriculture

Above is the coachwhip snake; in the center, a gopher snake eating a garter snake. Below are the bull snake (left) and the corn snake (right)

of white with forty-five black rings encircling the body, each ring enclosing some red separated by narrower whitish rings.

These snakes are all essentially snakes of the ground. They vary greatly in disposition, some being always perfectly docile and others biting viciously but futilely. They lay eggs, the young emerging as shown in the picture on page 424. They are universally valuable apparently. Scientific name of the milk snake, *Lampropeltis triangulum*; of the king snake, *Lampropeltis getulus*; of the scarlet king snake, *Lampropeltis triangulum amaura*; of the coral king snake, *Lampropeltis multicincta*.



Photograph by C. W. Leister

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A water snake swallowing a bullhead or catfish. This illustration shows well how the jaws of a snake may expand. Water snakes are not poisonous

WATER SNAKES

Natrix

SIZE: Thick body, 16 to 32 inches long.

RANGE: Throughout northern United States and southward to Mexico.

As the name implies, these snakes live in and near water. Their food is largely fish, though they eat frogs and toads readily. The head is distinct from the body, in the water snakes, and they have rough scales in from nineteen to thirty-three rows. They are black or brown in color, striped longitudinally or with transverse bars. The color varies considerably, depending on how recently the skin has been changed. The queen snake found east of the Mississippi has longitudinal stripes and the common water snake and water-

pilot snake have transverse bands or spots, those in the water-pilot being usually large square blotches.

Water snakes may become docile with handling but at first they tend to fight back viciously. They are considerably less harmful than a kitten. They should not of course be confused with the cottonmouth moccasin. They give birth to living young.

GARTER SNAKES

Thamnophis

SIZE: Small slender snakes, $2\frac{1}{2}$ feet or less in length.

RANGE: From coast to coast and at least from Canada to Guatemala.

Garter snakes are generally the most convenient and the easiest snakes to study. There are about twenty-four species in North America, living essentially on the ground, usually among the grasses. Garter snakes feed to a great extent on earthworms, toads, and frogs and are therefore not economically valuable. In general they are greenish in color with a great variety of yellow longitudinal stripes or crossbands. The head is rather distinct and the scales, in nineteen to twenty-one rows, are rough or rather ridged. In the ribbon snake which is slightly more slender than the average garter snake, the yellow longitudinal band is on the third and fourth rows of the nineteen rows of scales present.

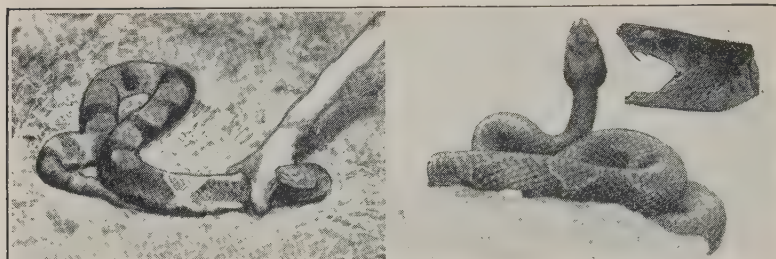
Garter snakes mate in early spring, giving birth to living young in late summer. They have a most unpleasant odor at times.



Photograph by C. W. Leister

©The Classroom Teacher, Inc.

The head of the garter snake is rather distinct from the body



Photographs by A. B. Klotz

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The illustration at the left shows a method of catching the copperhead. That at the right shows the typical shape of the head and of the hourglass markings of the body

COPPERHEAD SNAKE

Agkistrodon mokasen

SIZE: Thick-bodied snakes, $2\frac{1}{2}$ feet or less in length, one-seventh of the length being tail.

RANGE: From Massachusetts to Florida and west to Illinois and Texas.

The coppery color of the copperhead snake is a reasonably safe distinguishing characteristic of both the young and old snakes. The back has about fifteen crossbands of a darker brown than the basic color of the snake, which are narrow on top and very broad at the sides, somewhat resembling the shape of an hourglass. The head, which is remarkably distinct from the body, is copper red and the belly is whitish with a series of large dark spots. The scales are ridged in twenty-three rows. Copperheads feed on a variety of types of food, including frogs, birds, mice, and rats. They are very poisonous though not unusually aggressive unless they are disturbed.

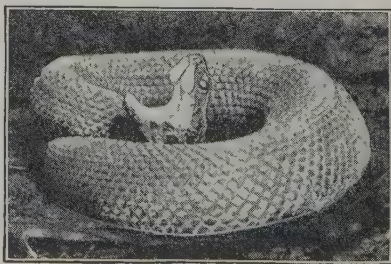
COTTONMOUTH MOCCASIN

Agkistrodon piscivorus

SIZE: 3 to $3\frac{1}{2}$ feet in length.

RANGE: Atlantic and Gulf drainage from Virginia to eastern Texas.

The cottonmouth, or water, moccasin is closely related to



A cottonmouth moccasin about to strike

the copperhead. As the scientific name implies it is a fish-eater, but it also eats other snakes and other types of animals. Cottonmouths get their common name from the habit of opening their mouths wide before striking, showing the very white inside. These snakes are olive-brown in color with twenty to thirty obscure dark crossbands. The head is purplish-black and the belly yellow with dark blotches. The scales are reddish and in twenty-five rows. The cottonmouth moccasins are possibly the most poisonous snakes in the United States. They, like the copperheads, give birth to living young whose poison is very virulent from the beginning.

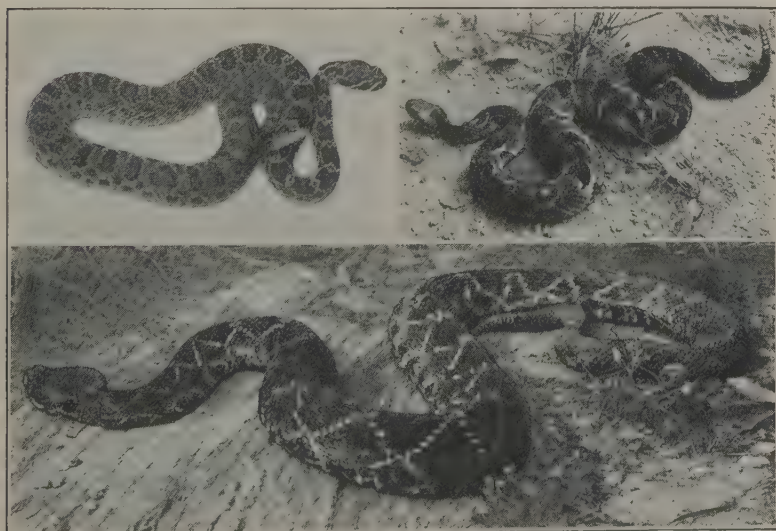
RATTLESNAKES

Crotalus

SIZE: The species vary in length up to 6 feet.

RANGE: Widely distributed in North and South America.

The rattles on their tails are the most easily distinguished characteristic of the rattlesnakes, of which there are fifteen species in the Americas. These rattles appear after the skin has been once shed.



Photographs by Elwin R. Sanborn Courtesy, The New York Zoological Society, New York City
 Above, at the left, is the prairie rattlesnake; at the right, the yellow-banded rattlesnake. Below is the diamond-back rattler

The head is remarkably distinct from the body and the top of it is covered with scales. The scales of these snakes are ridged. The tail of the common rattlesnake, when the individual is adult, is all black. In the diamond-back rattler the tail is crossed with black or dark brown. This is also the case with the sidewinder and the prairie rattler. In the last two there is a series of separated blotches appearing down the back. The prairie rattler lacks a pair of horns which appear between the eyes of the sidewinder.

Rattlesnakes rarely if ever attack humans unless they are molested or surprised. They feed upon the ground on many small warm-blooded animals and probably do little good to offset their dangerous bites. Undoubtedly there are more people reported to have been bitten by rattlesnakes than is actually the case. These snakes give birth to large litters of living young and are found in a variety of types of environment. Scientific name of the common rattlesnake, *Crotalus horridus*; of the diamond-back rattlesnake, *Crotalus adamanteus*; of the sidewinder, *Crotalus cerastes*; and of the prairie rattler, *Crotalus confluentes*.

The pigmy rattlesnakes belong to a different genus, *Sistrurus*. They reach a length of thirty-two inches and are found in four species in North America. These snakes include the massasauga and the ground rattler. Pigmy rattlesnakes have the top of the head covered with broad plates, each of which extends from the snout back between the eyes and a similar distance beyond the eyes.

CORAL SNAKE

Micrurus

SIZE; 3 feet or less in length.

RANGE: South Atlantic and Gulf states from South Carolina to Texas.

The coral snake, closely related to the cobra of India, is probably the most deadly



Photograph by Elwin R. Sanborn
Courtesy, The New York Zoological Society
New York City

The poisonous coral snake

American snake. The head is small and the scales are smooth and in fifteen rows. About fourteen broad red bands separated from a similar number of broad black bands by narrow yellow rings appear on the body. The head and tail have only the yellow and black bands. The coral snake is a burrowing snake and feeds on lizards and other snakes.

TURTLES

Turtles are interesting whether we consider them from the standpoint of their economic importance or from their habits. The presence of their protecting shells distinguishes them from other animals generally, though some turtles have soft leathery shells that can hardly be considered as offering the protection given by the plates on such mammals as the armadillos, for example. Like other reptiles, turtles are cold-blooded, their temperature being essentially that of the surrounding element. Though most of them are essentially aquatic, all of them come to land to lay their eggs and some live continually on land. The sea turtles reach enormous sizes and come to land only for the purpose of laying eggs.

It is reasonably safe to say that turtles the soft parts of whose bodies are well protected by shells are generally less aggressive than those in which parts of the body are susceptible to attack by enemies. Young turtles resemble the adults in general characteristics. Data are not available concerning the length of time turtles live, but it is certain that they are long-lived animals.

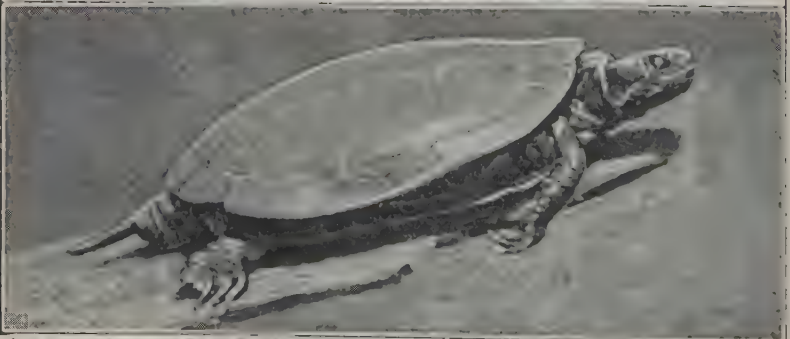
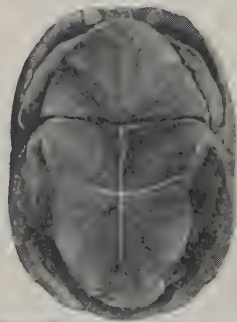
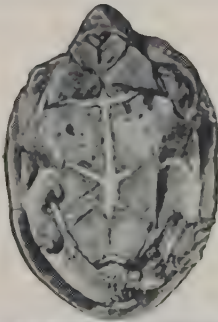
MUSK TURTLES AND MUD TURTLES

Kinosternon

SIZE: Shell of various species, from 3 inches to 3 feet long; of musk turtle, generally not over 6 inches long. Tail, short.

RANGE: From the Atlantic coast to southeastern California and into Mexico.

It is not safe to classify all turtles that are ordinarily called mud turtles under this heading, since to many people any turtle that



Left center photograph by A. B. Klotz

©The Classroom Teacher, Inc.

Right center photograph, courtesy, Bureau of Fisheries

The musk turtle is shown above; the mud turtle, below. Notice the hinges on the undershell of the mud turtle (right center) and compare the undersurface with that of the musk turtle (left center)

lives in the mud is a mud turtle. The turtles here considered have two hinged and movable portions to the lower shell, and in this respect differ from the other turtles except the box turtles. The upper shell has horny plates and the margin is turned down rather than flaring as in some species. The lower shell has nine to eleven horny plates and the front and rear lobes are movable. The musk turtle has a narrow and very poorly developed undershell which does not cover the soft parts, and a rather high-arched back. In the mud turtle the undershell is much larger. These turtles have pointed heads with strong jaws and are aggressive little fighters. They feed exclusively on animal matter which is caught under water. These turtles are sometimes called "stink-pots" because of the musky odor which they emit.

PACIFIC TERRAPIN, WOOD TURTLE, SPOTTED TURTLE

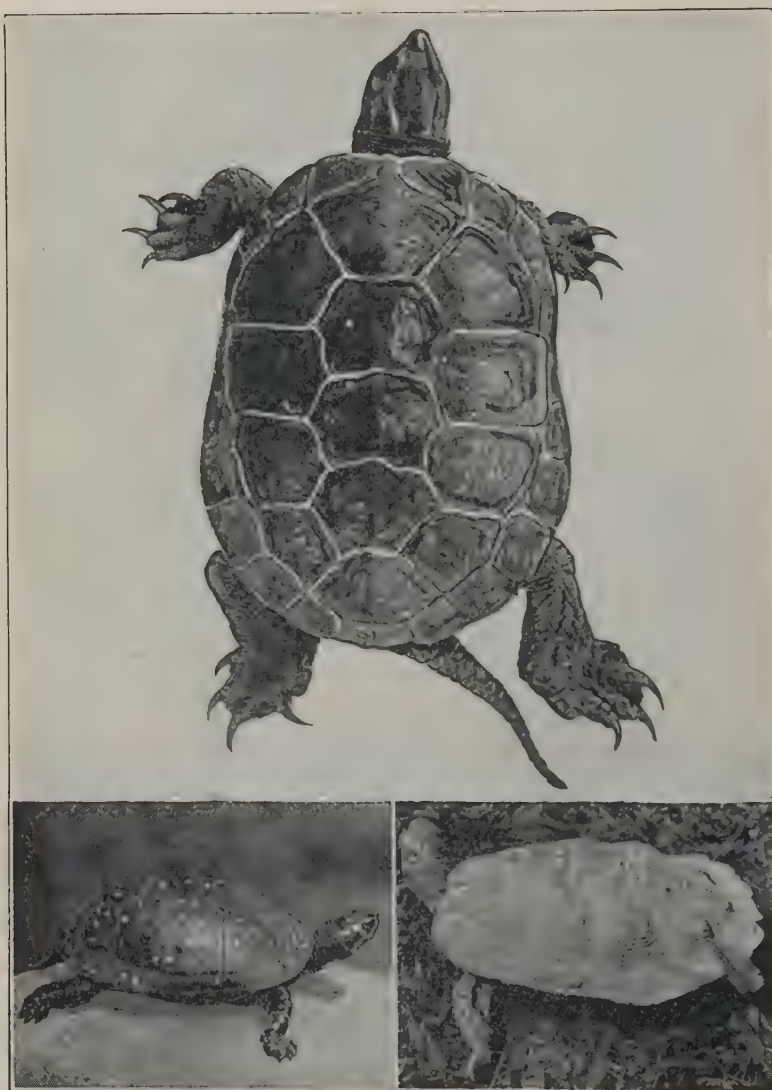
Clemmys

SIZE: Shell of wood turtle, up to 1 foot in length; of Pacific terrapin and eastern spotted turtle, about 6 inches.

RANGE: Pacific terrapin, along the Pacific coast from Puget Sound to Southern California; wood turtle, Iowa to Maine and south to the District of Columbia; spotted turtle, Iowa to Maine and south to Florida.

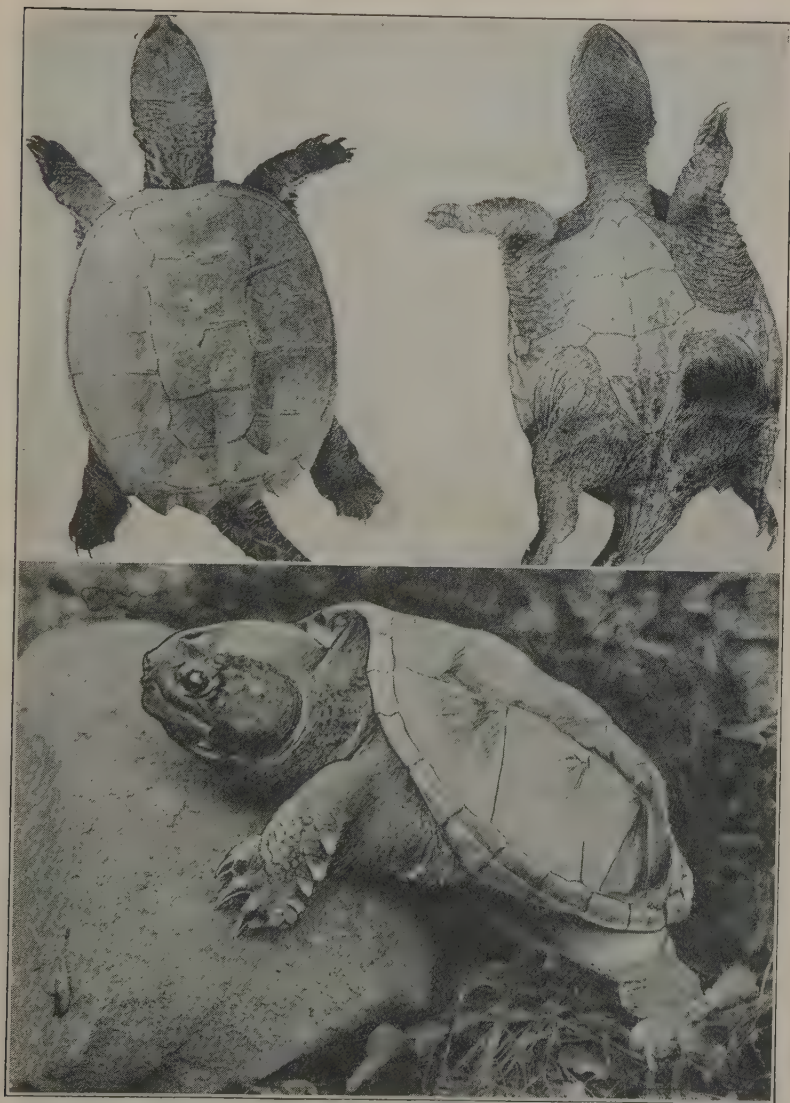
All of these turtles, as well as the painted turtles and the box turtles, belong to a single family, the *Testudinidae*. They have the ability to withdraw the neck completely within the shell and generally have well-developed upper and lower shells. The shells are covered with horny plates and flare outward at the margin. The tail is short. The Pacific terrapin, wood turtle, and spotted turtle belong to the genus *Clemmys*, which is characterized by having an unhinged lower shell rigidly joined to the upper shell. Of these, the wood turtle is essentially, or rather, largely, a land turtle, while the others are ordinarily found only about waterways. The wood turtle and the Pacific terrapin are eaten by man, though in some parts of the country the wood turtle is now protected by law. Generally speaking, these turtles are docile creatures that may adjust themselves to handling and may even feed out of the hand.

The wood turtle, which is essentially eastern, has a dark gray or brown shell, much roughened by deep concentric grooves and ridges on each plate. The soft parts, except the top of the head



Upper photograph, courtesy, Museum of Vertebrate Zoology, University of California

The photograph at the top shows the Pacific terrapin, commonly used for food. At the left below is the spotted turtle, a creature of the ponds, which serves as a general scavenger. At the right is the wood turtle, useful as an insect destroyer



Upper photographs, courtesy, Bureau of Fisheries

Common snapping turtles. The upper photographs show the horny plated upper shell and the poorly developed lower shell. The snapping turtle may become a serious menace in a duck pond or a fish pond. It serves better as soup than as a bathing companion

and the limbs, are red. These turtles may emit a hissing noise when disturbed. They feed upon plants and small animals, particularly insects, and are probably as useful as any turtle from this standpoint.

The Pacific terrapin is the "mud turtle" of the Pacific coast and the creature commonly sold there as "terrapin." It is the only common fresh-water turtle west of the Rockies except in certain limited areas.

The spotted turtle has a dark upper shell with conspicuous, though small, yellow spots. The Pacific terrapin is somewhat similar, with small yellow dots or dashes. The spotted turtle feeds upon a variety of things, including plants and animals, and it may serve as a scavenger in removing dead animal matter from ponds. Scientific name of the Pacific terrapin, *Clemmys marmorata*; of the wood turtle, *Clemmys insculpta*; of the spotted turtle, *Clemmys guttata*.

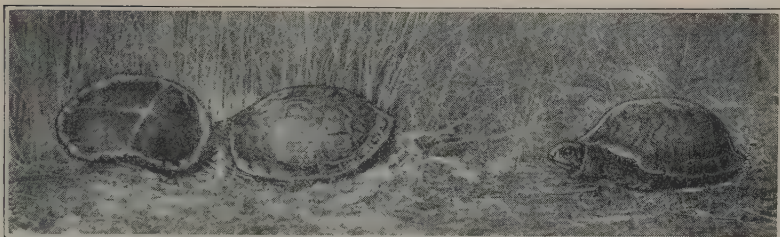
SNAPPING TURTLES

Family *Chelydridae*

SIZE: Common snapping turtle, about 14 inches long; weight, 40 pounds. Alligator snappers, 30 inches long; weight, 140 pounds.

RANGE: Common snapping turtle, east of the Rocky Mountains through southern Canada to the Gulf of Mexico; alligator turtle, along the Gulf of Mexico and from Florida to Missouri and Texas.

These turtles have horny plated upper shells and poorly developed lower shells, leaving their limbs free for motion. Their tails are long with a row of tubercles. The head of the common snapping turtle is covered with skin while that of the alligator snapper is covered with symmetrical plates. These turtles are most aggressive and powerful fighters. They can strike with their heads almost with the speed of a snake and their powerful jaws may inflict really serious damage. They feed upon all sorts of animal matter such as fish, ducks, rodents, and similar creatures. They must feed with their heads under water, and, as this implies, they are essentially aquatic. They are themselves good food for man. Scientific name of the common snapping turtle, *Chelydra serpentina*; of the alligator snapper, *Macrochelys temminckii*.



Courtesy, Bureau of Fisheries

Box turtles may close their shells so tightly that they protect all the soft parts of the body

BOX TURTLES

Terrapene

SIZE: About 6 inches in length.

RANGE: From Maine to Florida and from the Yellowstone River in the Rocky Mountains to Arizona and northern Mexico.

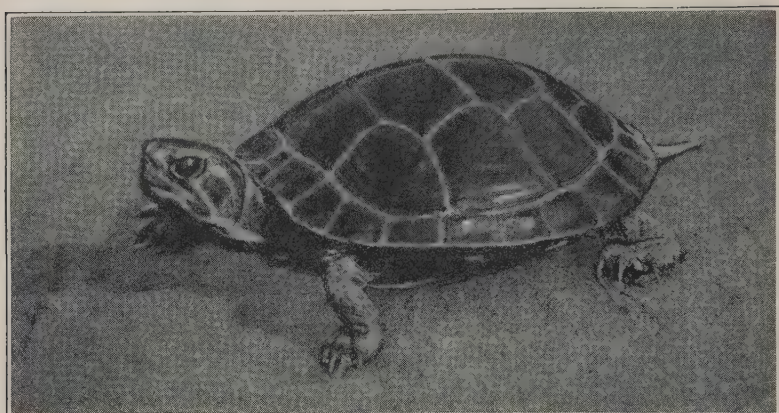
These creatures are so well named as to need little further description. The most interesting thing about them is probably the nicety with which they can close their shells and protect the soft parts of their bodies. The lower shell is hinged to permit this, and unless the animals are too fat, it is difficult to reach the soft parts of the body even by poking with a small stick. The upper shell is highly arched and usually has conspicuous yellow markings. It may be keeled or without a keel. The upper jaw has a hook in front. Box turtles are most useful destroyers of snails, slugs, and insects, and deserve the legal protection they get in some states. They are valuable as food to man, but the good they do is more lasting than the meal they might make. Box turtles are essentially land turtles and in this respect they differ from the mud turtles, whose shells are also hinged, though not to permit complete covering of the body. Scientific name of common box turtle, *Terrapene carolina*.

PAINTED TURTLES

Chrysemys

SIZE: Length of the upper shell, usually about 5 inches.

RANGE: From British Columbia and Vancouver Island east through New Brunswick and south to Oregon, Illinois, and Georgia.



The painted turtle is a meek little pet which learns rather readily to eat from the hand

These turtles are commonly seen about ponds on logs. They get their name from the red and yellow markings on both the margin of the shell and the sides of the head. The upper shell is not highly arched and is without a keel. The lower shell, which is yellow with black patches, is not hinged. Painted turtles make excellent pets and serve generally as scavengers in destroying animal matter which may be found dead in ponds. They also eat plants, insects, worms, and fish.

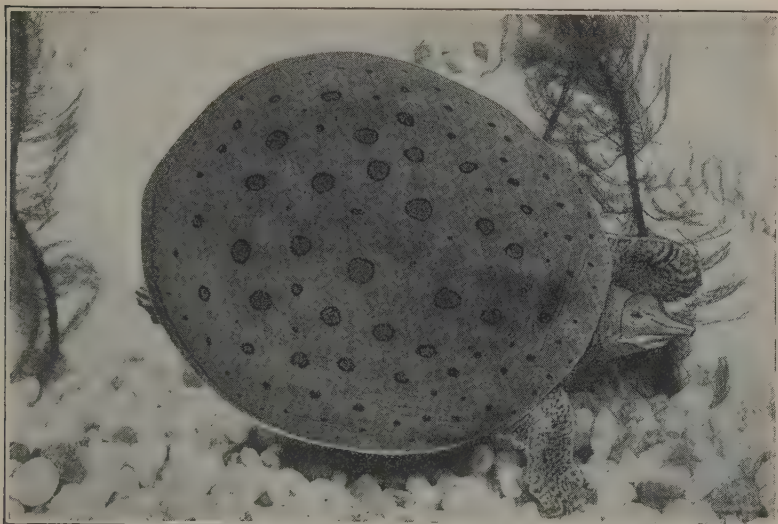
SOFT-SHELLED TURTLES

Amyda

SIZE: Body part at least 18 inches in length.

RANGE: From the St. Lawrence River to Montana and south to Georgia and Texas.

Members of the family *Trionychidae*, to which the soft-shelled turtles belong, are characterized by a soft, leathery skin over the body in place of the usual horny plates to be found on turtles. The soft-shelled turtle is remarkably flat and the underside of the body has little protection. The neck is very long and the head is slender with a sharp snout, which is flexible. These turtles are provided with sharp jaws and can dart their heads at their prey with great speed and skill. They are perfectly able to inflict severe damage on human beings. Soft-shelled turtles are essentially aquatic and



Photograph by Elwin R. Sanborn Courtesy, The New York Zoological Society, New York City
Soft-shelled turtles may look harmless, but they can "strike" with the speed of a snake. Their jaws are very powerful

can swim swiftly and powerfully. They are frequently caught on fish hooks and in fish nets. In the smooth soft-shelled turtle the back is smooth, and in the spiny soft-shelled turtle the back is spiny. Both are very light colored on the underside. There are a number of species of soft-shelled turtles.

LIZARDS

To many people, any long slender creature with four legs that travels by dragging its long tail along the ground is a "lizard." This definition is far from satisfactory, since it would include the salamanders among the lizards, and salamanders are not even reptiles. Furthermore there are lizards that do not have four legs, or for that matter any legs, and there are lizards that instead of dragging their tails carry them erect while they run rapidly on their hind legs.

Lizards, like the snakes and turtles, have scaled bodies though these scales may vary from very small ones to con-

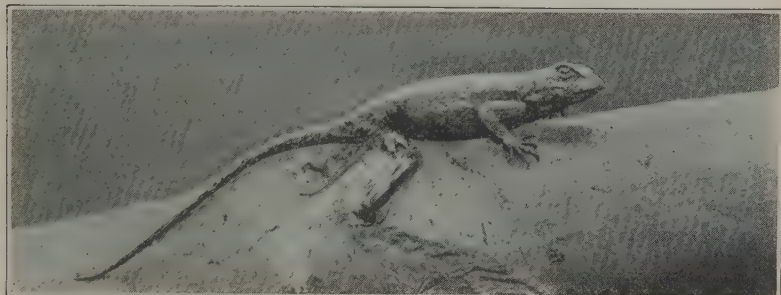
spicuous scales that cover the owner's body as though it were shingled. Then, too, there are lizards whose bodies are covered with beadlike structures that might not be considered as scales. The chameleons, swifts, and horned toads, descriptions of which are given in this section, belong to the *Iguanidae*, the members of which are characterized by possessing legs and a scaly body, the scales being either smooth or ridged. The tongue in these lizards, the *Iguanidae*, is thick and is not protractile. In the skinks it is protractile.

Lizards are found in North America from the northern part of the United States to the Gulf and on through Mexico. They are most abundant in the southwestern part of this range, both as to number of individuals and number of species.

The food of lizards varies from a strictly vegetarian diet to a diet of insects and cold-blooded animals. Only one species in the United States, the gila monster, is in any way poisonous, so with that exception the lizards of the United States may be handled in perfect safety. Even gila monsters may be handled safely if they have become accustomed to such treatment. True it is that most lizards may at first show a dislike for being held captive, by biting, but they can do no damage in this. Most of them make amusing pets if they can be provided with an environment similar to that which may be normal to the species. As a rule they are sun-lovers, though there are some burrowing species that avoid sunlight and some that are active at night.

We know that there are mammals, such as the bats, that fly; mammals, such as the squirrels, that climb, such as the woodchucks and moles, that burrow, and such as the rabbits, that run about on the ground. There was a time in the world when there were large flying lizards, and now within the limits of the United States there may be found lizards that do most of the other things that mammals do, except delight in swimming. From the standpoint of reproduction lizards offer a variety, in that some give birth to living young while the great majority reproduce by laying eggs.

Lizards are essentially useful members of the fauna and are worthy of protection. Many of them, like the chameleons, make splendid pets.



Photograph by A. B. Klotz

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The chameleon is primarily a tree-top lizard

CHAMELEON

Anolis carolinensis

SIZE: 7 inches in length.

RANGE: Coastal regions of the southern states from the Neuse River, North Carolina, into Mexico.

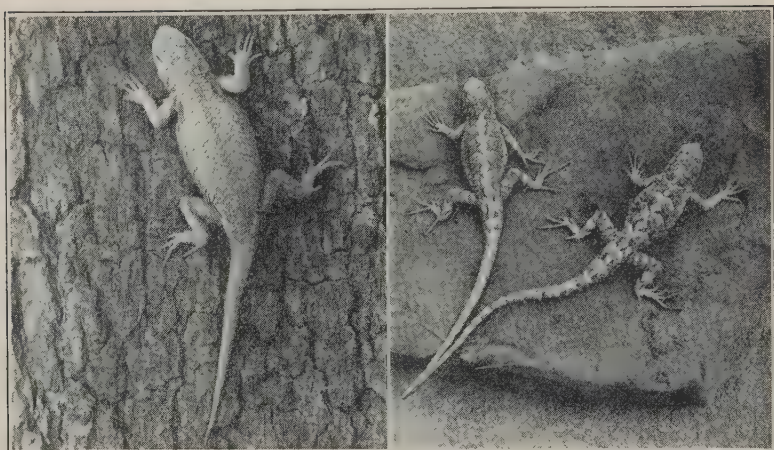
These are interesting little lizards with remarkable ability to change their color. In spite of the fact that it is generally believed that this color matches the background of the creature, this does not hold true. The chameleon is distinguished from other members of the family by having flattened toes. Chameleons live in trees and on fences, their food being largely the insects that may be found in such places. They are easily tamed and in captivity they learn to eat out of the hand.

SWIFTS

Uta (common swifts); *Sceloporus* (spiny swifts)

SIZE: Common swifts, 8 inches in length; spiny swifts, at least 10 inches in length.

RANGE: Common swifts, about 21 species in the southwestern United States and Mexico; spiny swifts, about 35 species mostly in desert regions of tropical America, several species entering the United States from Mexico.



At the left is the pine lizard, one of the swifts. At the right is a pair of swifts from Arizona

As their name implies, swifts are active lizards. They are found for the most part on the ground, over which they may run with startling rapidity. In most swifts the scales of the body are very conspicuous, generally being somewhat free at the end away from the head.

The swifts belong to two genera. Those of the genus *Uta* have small scales, which are ridged or not, and they have a collar of enlarged scales across the throat. They are spoken of as the "common swifts." The swifts of the genus *Sceloporus*, known as the "spiny swifts," lack the collar of larger scales and have ridged scales which are sharply pointed and bristling. The color is variable, depending upon the species and, in some species, to a considerable extent upon the age. The swifts have thick tongues that are not protractile.

Swifts reproduce by laying eggs. The young frequently differ so greatly from the parents in general appearance that they might easily be taken for separate species. The males frequently differ from the females by the possession of more brilliant colors. Swifts of most species may be captured by means of a slip noose of hair tied to the end of a pole. Most swifts and many other lizards may escape capture by shedding their tails, a new tail growing on where the old one was shed.

HORNED LIZARDS, OR HORNED TOADS

Phrynosoma

SIZE: 3 to 6 inches in length, with broad, flat bodies.

RANGE: Southwest of a line from the state of Washington through Kansas and Texas.

These creatures are well known to most residents or tourists in the southwestern United States. Unlike the swifts and chameleon, they have broad, flat bodies and horns on their heads. They vary considerably in color. Horned lizards are found to be active in the hottest part of the hottest, driest of desert places. When night approaches they burrow in under the ground, using the "horns" on their heads and the rough edges of the sides of their bodies. If given a fair amount of care, horned lizards make intensely interesting pets. They feed almost exclusively upon insects, which they capture in much the same manner as do the toads.

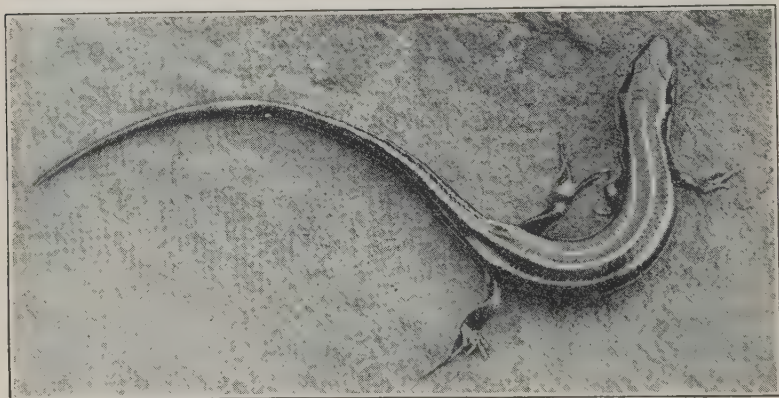
At first one is inclined to fear horned toads because of their unusual appearance. If there is justice for any fear, that fear should be expressed by the lizard. Some individuals will puff themselves up as much as possible and others will flatten themselves as much as they can. Still others will apparently try to use their horns, though no harm could be done with them. Some will do the most



Photograph by E. Laurence Palmer

A horned toad makes a good pet, but it seldom receives the attention that it deserves

interesting trick of expelling a fine stream of blood from the eye in the direction of the offending person. Horned toads reproduce by giving birth to living young, not in the same sense that mammals do, but in much the same sense as do certain snakes. The young merely develop through the egg stage within the mother. They do not, however, take nourishment from the mother as do mammals.



The blue-tailed skink is very common in the South

SKINKS

Plestiodon

SIZE: About 3 to 12 inches, depending on the species.

RANGE: From southern New England to Florida and west to Oregon and Mexico.

These are active, slender-tailed, smooth-scaled lizards, twelve species of which are found within the limits of the United States. Members of the family *Scincidae*, to which the skinks belong, are found both with and without legs, but in those of the commonest genus, *Plestiodon*, the legs are normal. The members of this genus vary considerably in color pattern, though they generally are striped. The food of the skinks is almost exclusively insects and other forms of small animals. They escape by means of their short legs or by a rapid worming motion, much like that of snakes. The young and old of a number of species differ very materially from each other both in coloration and in general shape and appearance. Most skinks make good pets. They reproduce by laying eggs.

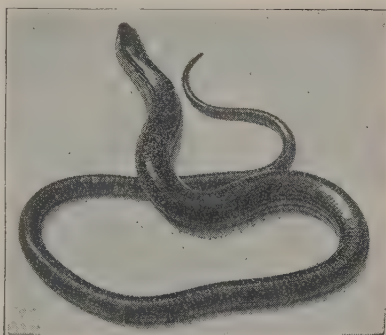
GLASS SNAKE

Ophisaurus ventralis

SIZE: Nearly 2 feet in length.

RANGE: Most frequent in the southern United States; found also north to Wisconsin and south into Mexico.

This is a queer greenish or brown burrowing lizard without legs. It has a median and two lateral stripes. Unlike snakes, it has eyelids, a scaly belly, and distinct ears. It sheds its tail easily. It is common in dry meadows, where it feeds on insects and worms.



Photograph by Elwin R. Sanborn.
Courtesy, The New York Zoological Society
New York City

Because of its very brittle tail this lizard is called the glass snake

GILA MONSTER

Heloderma suspectum

SIZE: Nearly 20 inches in length, with a thick body.

RANGE: Southwestern United States east of California, and into Mexico.



Photograph by Elwin R. Sanborn Courtesy, The New York Zoological Society, New York City

The poisonous gila monster has a thick, brightly colored body

The gila monster, a unique lizard with beadlike scales, is the only poisonous lizard in the world. It is brightly colored, pink or yellow on a black or purplish background. The poison fangs are in the lower jaw.

AMPHIBIANS

A graduate of a high-school course in biology once stood beside a beaver dam and made these remarks: "These beavers live on land and water, do they not?" The answer came, "Yes." "Well, then," said the student, "since they live on land and water, they are amphibians and since they are amphibians they lay eggs and have gills. Where are the beaver's gills and eggs?" This is merely mentioned as a picture of what the word "amphibians" or "amphibia" may bring up in the minds of some. The boy was wrong in assuming that all creatures that live on land and water are amphibia, though they might be described as being amphibious.

Amphibia do lay eggs and most amphibia do bear gills at some stage of their lives but not all amphibia live both in water and on land. Generally speaking, the amphibia are divided into two groups, one including the frogs and toads and being usually tailless as adults, and the other including the salamanders which are generally and normally tailed as adults. Other differences and similarities between the groups are brought out in the discussions of the groups. Amphibia generally are smooth skinned.

FROGS AND TOADS

The story of frogs and toads is an interesting one whether we study it from their economic importance, their life-history habits, or the variations which adapt the individuals to the type of life which they live.

Frogs and toads are amphibians like the salamanders. In a majority of cases they lay their eggs in water rather than on land, as is the case with the turtles and other reptiles. Their bodies, like those of the salamanders, and unlike most of

those of the reptiles, are devoid of scales. They may or may not be moist to the touch. Sometimes a distinction is made between the salamanders and frogs and toads by which the salamanders are spoken of as the "tailed batrachians" and the frogs and toads as the "tailless batrachians." This, of course, refers to the adult stage, since most frogs and toads in the immature or tadpole stage have well-developed tails. There are a few species in which the tadpole stage is spent within the eggs, which may be laid among damp plants on the ground, and in this case the little frogs that emerge from the egg have the general form of the adult. There is one species to be found in the northwestern part of the United States in which the adult retains at least a semblance of a tail. Another peculiar species places the eggs on the back of a parent and there they remain until they hatch.

In general, the life history of frogs and toads consists of an egg stage followed by a tadpole or larval stage and that followed by a stage in which the adult form is assumed, though the individuals may not necessarily be sufficiently mature to produce eggs. In spite of the belief of many people, frogs and toads do not shed their tails when they transform from the generally aquatic tailed tadpole stage to the tailless, frequently terrestrial, four-legged adult form. The tail material is used to build up new tissues and structures of the transforming animal. Another interesting difference between the adult form and the tadpole stage lies in the fact that the adult is an air breather while the tadpole may use internal gills to help in respiration.

Adult frogs and toads generally migrate to ponds and streams in the spring of the year for the purpose of laying their eggs. At this time, the males develop considerable vocal talent. The males, too, tend to wear more brilliant colors on their throats or, at least, their throats are farther from the traditional "lily-whiteness" possessed by the female of the species. Each species of frog or toad possesses a call which distinguishes it from other species as definitely as the calls of birds distinguish one species from another.

The eggs of frogs and toads vary considerably. The common toad lays its eggs in long strings, which quickly become sediment-covered and obscure. Most of the frogs lay their eggs either singly or in masses. Generally those species that lay their eggs earliest in the spring lay them deepest in the water, possibly to avoid freezing. The species which lay their eggs later, such as the green frogs and bullfrogs, lay them in great masses near the surface of the water. The life of a frog and toad is one of almost continual danger, and, since it may take a number of years to produce an adult capable of laying eggs, it is necessary that a very large number of eggs be laid if a species is not to be exterminated. Frogs and toads seem to be the legitimate food of many snakes, birds, fish, mammals, and even of others of their kind. This leads one to appreciate why it is rather safe to generalize and say that those species that require the longest time to reach maturity frequently lay the largest number of eggs. Generally speaking, the frogs of the larger stature require the longer time to reach maturity.

The tadpole stage of various frogs and toads varies from a few weeks to well over a year. Shortly after hatching many tadpoles show external gills in loops at or near the side of the head. Through these gills one may see the blood movement with a hand lens and "take the tadpole's pulse." This is easy to do in an aquarium since at this time the tadpoles usually appear head up, on the glass sides of the aquarium. The tadpole stage is essentially one in which the main purpose of the individual is to increase in bodily stature.

At this time the food is largely the ooze and slime covering the bottom of waterways. This should be remembered by those who wish to raise tadpoles to the adult stage in aquariums. Too frequently people put tadpoles in clean glass jars of water and then wonder why the tadpoles do not grow. Another experiment that frequently results in disappointment is that of taking the eggs or tadpoles of individuals that spend a year or more in the tadpole stage and then wondering why the creatures do not transform quickly into the adult

form. This does not happen so frequently in schools as would be the case if the species that have a long tadpole stage laid their eggs early in the season. Generally these species are among the last to lay their eggs.

If you have been able to distinguish between the calls of various species of frogs it may be comparatively easy to appreciate the time of year when the eggs are being laid. The peepers that open the spring chorus lay their eggs among the first, and the bullfrogs and green frogs that sing bass in early summer are among the last to lay their eggs. To be sure, one may hear frogs through most of the summer under certain conditions, but these calls are not to be compared with the chorus of the mating period.

When the tadpoles of frogs and toads transform, the hind legs of the adult form generally appear first. These are followed by the fore legs and then by the absorption of the tail. At or about this time the creature may desert the water in which it has been living and take up life on land, if it is a land species. Frequently this may happen at about the time of a heavy rain and the presence of large numbers of little frogs, or more generally toads, after a rain makes some people believe that the creatures came down with the rain. If the rain is responsible for their moving in any direction it is, as is the case with the earthworms, a factor which makes the creatures move up rather than down.

Once a frog or toad has taken on the adult form, it does not change remarkably except in size. To be sure many species require a development of a number of years, even after the tadpole stage, before the creatures are sexually mature. They may spend the winters underground beneath the frost line in a practically torpid condition. When the breeding season commences, those species that have been living on land—and most species do this—migrate to the ponds and waterways. Generally, as is the case with many birds, the males precede the females in this migration.

Economically frogs and toads are most useful, as their food is largely living insects, though they eat also many forms of

small animals. One has been known to eat a young alligator. There is probably little sense in sacrificing an adult insect-eating frog for the food value which a human may get from eating its hind legs, but man is of course not always logical.

In some parts of the country frogs are protected by law, particularly during the breeding season. It would seem most reasonable to believe that this protection should be further extended. Undoubtedly before this happens the public will have to be educated to appreciate the enormous amount of good done by these creatures in destroying insects.

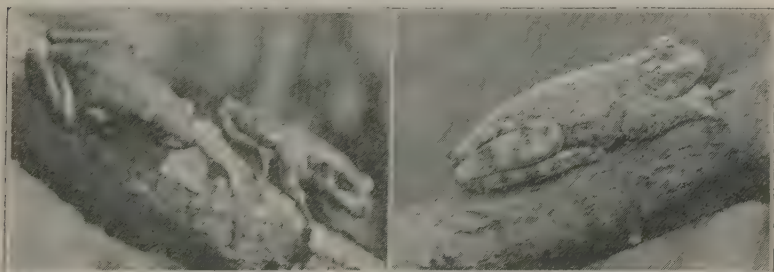
Frogs and toads protect themselves in a variety of ways, though generally it is a matter of avoiding detection rather than offering resistance. The ability of frogs to escape of course is very valuable to them at times. Some species are able to secrete from their skins juices which are distasteful to their enemies. The wartlike protuberances on toads are connected with this function. The material secreted cannot produce warts on creatures that molest the toads, however. Frequently these glands appear very conspicuous, particularly just after the creatures have changed their skins. Those who have not had the opportunity of watching one of these creatures change its skin and then eat it have an interesting experience in store for them.

Frogs and toads serve as destroyers of insects in a great variety of types of environment. The peepers and tree toads care for the trees. The meadow frogs care for the grassy lands. The common toads range over ground like that of our gardens. The wood frogs are adapted to the forest floor and the green frogs and bullfrogs remain in or near ponds and perform their services there.

Not all the frogs that are listed more or less technically as tree frogs or tree toads live in trees, though most of them do. These creatures are generally small in size and provided with most unique tips to their fingers and toes. Sucking discs or "sticky" discs on these members make it possible for their owners to cling with great ease to trunks and branches of the trees and shrubs where they spend most of their time. Among

the better-known tree frogs are the peepers, the cricket frogs, and the tree toads.

The true frogs include a great variety of species, among the more universally common and better-known species being the leopard frogs, the green frogs, the bullfrogs, and the wood frogs. Of these the leopard frog and the wood frog are essentially land species and the green frog and bullfrog, essentially water species. The green frogs and bullfrogs are also considerably larger than the other two mentioned.



Spring peepers (left) and a tree toad (right) clinging to trees by the discs on their fingers and toes

PEEPER

Hyla crucifer

SIZE: About 1 inch in length; hind leg stretches to nearly 2 inches in length; body, small.

RANGE: From New Brunswick south to Louisiana and South Carolina. Other species increase this range greatly.

The spring chorus of peepers is ascribed by many to lizards, by others to turtles, and by still others to insects. It is not surprising that superficial observers should be mistaken in the individual making the noise, for peepers are usually difficult to locate. The common peeper is a little frog about an inch long, varying in color from yellow to deep brown and often reddish, with a dark oblique cross on the back and a similarly colored V between the eyes. The female is slightly larger than the male and lacks the dark-brown throat. The eggs hatch in about two weeks and are laid singly among plants under the water surface. A single female may lay as many as a thousand eggs. The tadpole stage lasts between two and three months.

TREE TOAD

Hyla versicolor

SIZE: About 2 inches in length; hind leg stretches to over 3 inches; body, stout.

RANGE: From Maine to Minnesota and south to the Gulf states. Other and somewhat similar species extend this range greatly.

Tree toads of this species are about twice as long as the peepers and bear rather "warty" skins which make it very difficult to see them against rough bark. The color varies greatly, from almost white to bright green or dark brown and more or less mottled, with a dark mark on the back somewhat the shape of a walnut meat and with other dark spots on the legs and between the eyes. The males are dark-throated.

The eggs are laid in small films of about a score of eggs at or near the water surface. They hatch in less than a week and the tadpole stage lasts about two months. The tadpole is nearly two inches long and has a scarlet or orange tail with black spots. The adults are the creatures commonly spoken of as "rain toads," not because it is thought that they rain down, but because it has been thought that their calls had significance in connection with rain. They may become mature within three years.

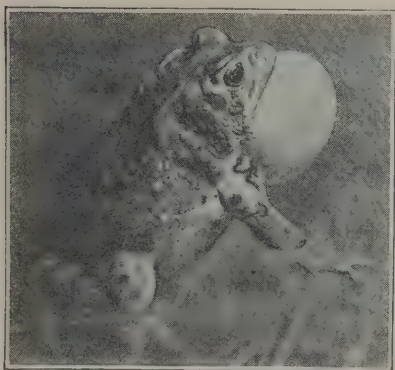
TOAD

Bufo americanus

SIZE: Male, nearly 3 inches long; hind leg stretches to between 3 and 4 inches; body, heavy and generally fat. Female considerably larger than male.

RANGE: Through eastern North America from Hudson Bay south. Other species of the same genus are found within this range and still others extend through most of North America.

The common, or American, toad is probably one of the best-known amphibians. It is worthy of even better acquaintance. The dry warty skins of adults sometimes are repulsive to certain individuals and the false rumor that they may give "warts" has not brought the species into the favor it deserves. Common toads serve the useful function of insect-destroyers for broken ground, and their warty skins make an admirable camouflage in such an environment. In color, these toads vary from yellow to gray, brown, or



Photograph by C. W. Leister
©The Classroom Teacher, Inc.

American toad, trilling. Only the males call. This picture is a flashlight

sometimes red. The call of the male toads is a distinctly musical prolonged trill.

The eggs, laid in long strings, hatch into tadpoles in from one to two weeks, and the tadpoles themselves are remarkably black with dark iridescent bellies. The tadpole stage lasts from one to two months and the toads at transformation time are only about two-fifths of an inch long. It is they that so frequently give rise to the idea that "it rains toads."

WOOD FROG

Rana sylvatica

SIZE: About 2 inches in length; hind leg stretches to between 3 and 4 inches; body, small and slender.

RANGE: From Quebec to South Carolina and west to the Great Plains.

As one goes through the woods he may be startled by a small rather unusually long-legged frog that seems to leap from nowhere to nowhere. At least, when it is still it cannot be easily seen. This is due generally to the ability of the frog to assume a color similar to the general environment in which it lives. An individual may be very dark at one time and later, a light tan color like that possessed by dead leaves. This wood frog has a dark brown patch back of the eye, which is conspicuous on a uniformly colored background, but renders the frog inconspicuous on the irregular litter of the forest floor.

Wood frogs do not have



The wood frog is the least aquatic of the frogs. It is usually found in damp woods

musical voices like many other frogs, but possess a rather disappointing croak. The males at breeding season give a sharp, snapping, clacking sound. From 2,000 to 3,000 eggs are laid by a single female in several spherical bunches. These hatch in from one to three weeks. The tadpoles transform in from six to twelve weeks when they have reached a length of nearly two inches. The transformed frog is only about two-thirds of an inch long, while an adult may be three inches long. The adult stage is not reached for about four years. The tadpole may be recognized by the pinkish belly with a bronze iridescence.

LEOPARD FROG OR MEADOW FROG

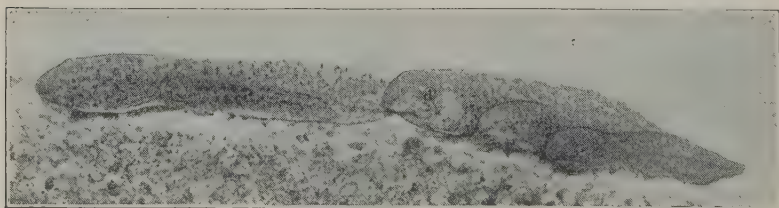
Rana pipiens

SIZE: Nearly 4 inches; hind leg stretches to 6 inches; body, stout.

RANGE: Through North America east of the Sierras and south into Mexico.

This species is the common creature of meadowlands that shows a back and general upper surface of gray, green, or brown with one to three irregular rows of long, rounded, dark spots, each edged with light yellow or white. The belly is white. The pickerel frog, which is somewhat similarly colored, may be distinguished by the yellow color of the under part of the hind legs, which in the leopard frog is white, and by the spots, which are more nearly square than rounded. Pickerel frogs are more generally found near water than may be the case with leopard frogs. The mink frog looks somewhat like these, but is olive green with the spots on the rear parts and possesses an odor like minks. The meadow frog and pickerel frog give no remarkable calls other than low croaks. They do not possess the ability to inflate their throats in the way the toads do, as shown in the picture of the toad on page 453.

Female leopard frogs lay about 4,000 eggs each. The eggs are in



Leopard-frog tadpoles



Top, green and leopard frogs. The green frog lacks the conspicuous spots of the leopard frog. Center, male and female green frogs. The male (right) has the ear larger than the eye. Below, pickerel frog (left) and leopard frog (right)

masses beneath the water surface. They hatch in from one to three weeks and develop in from ten to thirteen weeks into tadpoles nearly three and one-half inches long. These tadpoles transform about midsummer into the adult form, the little frogs being about an inch long, while the adults are nearly four. It probably takes at least three years after transformation for a leopard frog to reach maturity.

GREEN FROG

Rana clamitans

SIZE: About 4 inches long; hind legs stretch to at least 6 inches; body, large and heavy.

RANGE: Through eastern North America.

This species is the one that makes a noise like a stone being thrown violently into the water. It sounds like a "Tchung." The maker of the noise is a rather large greenish frog that possesses two prominent wrinkles down the back, which easily distinguish the frog from the bullfrog, which lacks them. The sides and legs bear dark spots and bars. The throat of the male is yellow and that of the female is white.

Green frogs, or spring frogs, as they are sometimes called, lay their eggs in early summer near the surface of the water. In fact, the eggs float on the surface. A single female may lay as many as 4,000 eggs. These hatch in less than a week and the larvae spend a year in the tadpole stage. The fully developed tadpole may be between three and four inches long. It has a yellow or rather creamy belly and a tail with brown mottlings. The little green frog at time of transformation is nearly two inches long. It takes probably at least three or four more years to attain sexual maturity.

BULLFROG

Rana catesbeiana

SIZE: 8 inches or more in length; hind leg stretches to 10 inches; body, large.

RANGE: North America from the Atlantic Ocean to the Rocky Mountains, in ponds and streams.

The well-known "jug-o-rum" call of the bullfrog has been mentioned frequently in all sorts of literature. The frog is one of the



The bullfrog is essentially a useful aquatic species

larger species and spends most of its life in or near water. It may be distinguished from the green frog, which it rather closely resembles, by a wrinkle which runs around each ear. Bullfrogs lay their eggs in early summer at the surface of the water. A single female may lay as many as 20,000 eggs. These hatch in less than a week and the tadpoles spend two years developing to a length of nearly six inches. The tadpoles have yellow bellies and tails with regular, round black spots. The frog at time of transformation is about two inches long, though a mature adult may measure seven or eight inches when at rest. A bullfrog seven or eight inches long was in the egg stage at least nine or ten years before.

SALAMANDERS

Salamanders are intensely interesting and generally useful little creatures that live in a variety of types of places and consequently vary considerably in form and habits. Salamanders are frequently spoken of as "lizards," possibly because of their general resemblance to the form of many lizards. As this implies, most salamanders are creatures with well-developed tails and four poorly developed legs. The leg development in salamanders is much inferior to that of the commoner lizards, and ability to move rapidly is generally

more poorly developed in salamanders. Probably the most conspicuous difference between salamanders and lizards, as implied in the account of lizards, lies in the possession of scaly skins by the lizards and of smooth, generally moist skins by the salamanders. This naturally leads one to expect to find salamanders generally in moist situations and lizards in dry situations, and such is the case.

All salamanders lay eggs. Generally these eggs are placed in water much as frogs' eggs are placed, but there are a number of salamanders that lay their eggs in damp vegetation on the ground (see Red-backed Salamander). The larval stages that develop from the eggs of salamanders usually are to be found in the water and usually possess external gills. Some species, particularly among those that live as adults in the water, may continue to possess external gills through their lifetime, but as a general thing adult salamanders lack external gills.

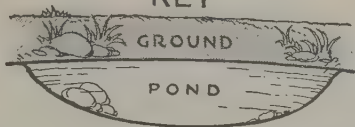
The larvae, or immature stages, of salamanders may resemble the adults quite closely or may differ greatly. In one species at least the difference is so great that the two stages were at one time believed to be two separate species. In certain other species, individuals which may possess all the general appearance of larvae may lay eggs and produce sperms.

The food of salamanders in the larval and adult stages is generally small forms of life. The early larval stages feed much as do the tadpoles of frogs, upon slime and ooze to be found conveniently.

A number of species of salamanders have aquatic adults. In some, such as the hellbender and the mud puppy, or water dog, the entire life is spent in water, though all salamanders spoken of popularly as "water dogs" are not of this type. In others, such as the newts, the adults live in the water while a part of the immature stages may be spent in water and another part on land. The chart on the opposite page shows the land and water stages of the salamanders described on the following pages.

SALAMANDERS

KEY



EGG



LARVA



ADULT



MUD PUPPY



DUSKY SALAMANDER



TWO-LINED SALAMANDER



NEWT



SPOTTED SALAMANDER



RED-BACKED SALAMANDER

Designed especially for THE CLASSROOM TEACHER by E. Laurence Palmer

Graphic description of the life histories of salamanders



Photograph by Elwin R. Sanborn Courtesy, The New York Zoological Society, New York City

The mud puppy is a repulsive-looking, dark brown creature, more or less spotted with darker brown and black

MUD PUPPY

Necturus maculosus

SIZE: About 2 feet or less in length.

RANGE: In tributaries of the Great Lakes, the Mississippi River, and the Hudson River, in water at least 4 feet deep.

Mud puppies are rather slimy, flat-headed, somewhat repulsive creatures with enormous mouths that reach from eye to eye and powerful finned tails. The rather huge fluffy ruffle of gills which is to be found at the neck region is always interesting to watch when the creatures are kept in aquariums. Mud puppies feed upon almost any forms of animal life that they are able to capture, and they are frequently very destructive to the young and eggs of valuable fishes. They are themselves of little, if any, value economically.

Mud puppies lay eggs in nests of sand under about four feet of sunlit water. An individual may lay about sixty eggs, each of which is cream-colored and covered with three jelly coats. The young that hatch from the eggs look much like the adults except in the matter of size. At the end of about ten weeks after hatching, young mud puppies may reach a length of about one and a half inches, and by the time the creatures have reached a length of about eight inches they are adults. There are people who contend that mud puppies are good as food, but their general characteristics will certainly forbid their ever becoming popular in this respect. Mud puppies are generally active throughout the year.

NEWT, EFT, EBBET

Notophthalmus viridescens

SIZE: Almost 4 inches in length, nearly half of which is tail; body, long and slender.

RANGE: Eastern North America from Hudson Bay to Texas.

This newt, when sexually mature, has a rather broad finlike tail. It is olive green above, yellow beneath, and generously sprinkled with black dots except on the belly. On each side is a row of two to six round red spots. The immature land stage is smaller than the



Upper and lower photographs by Elwin R. Sanborn
Courtesy, The New York Zoological Society, New York City

Above is the western newt, which is larger than the eastern newt. Below are the land (insert) and water stages of the common newt

adult, bright red in color, with the spots of the adult but with the tail lacking the keel.

The safest way to handle the life history of newts is to begin with the eggs, which are laid singly on plants under water. This is usually done in early spring or about the first of April. From the eggs hatch small aquatic newts that show external gills and possess four legs at a very early stage. These little newts develop in the water until about September, when they take up life on land and become pink in color, lose their external gills, and develop tails that are round in cross section. For two years these red land-newts continue to develop, coming out to feed during damp days. Their diet is largely composed of small insects. In this respect these creatures are undoubtedly valuable.

At the end of two years the newts return to the water and develop the adult characteristics discussed originally in this article. The creatures then mate, lay eggs, and continue their lives in the water. In the water, newts may become destructive of fish eggs. Male adult newts are generally slightly larger than the females; they possess rather broader tails, more swollen ventral regions, and larger necks.

The western newt, *Notophthalmus torosus*, frequently spoken of as a waterdog, has a very similar life history. The individuals are, however, considerably larger than the eastern newts. They range through California, Oregon, and Washington.

SPOTTED SALAMANDER

Ambystoma maculatum

SIZE: 6 to 7 inches in length, of which one-half to one-third is tail.

RANGE: Nova Scotia to Wisconsin and south to Texas and Georgia.

Throughout eastern North America the commonest salamander that lays its eggs under water and spends its adult life on land is probably the spotted salamander. These salamanders are not infrequently found in cellars in late fall and even in winter, and they may be seen in the spring migrating at night to the waterways to lay their eggs and breed. A good place to find them in spring is along some railway that borders a pond or under some boards or logs near such a place. During most of the year the individuals are



Spotted salamanders are active at night in fields, gardens, woods, and lowlands. After once leaving the water they live the remainder of their lives on land except when they return to water for the short breeding season

spread over such a large territory that it is mainly accident that permits one to find them.

Spotted salamanders are blackish- or greenish-brown with lemon-yellow spots of conspicuous size on the sides. They have cylindrical bodies and the tail is without a keel. The creatures possess no external gills. The skin is pitted with pores which, when the animal is molested, may exude a sticky substance which is evidently distasteful to many enemies.

Spotted salamanders are essentially night creatures. They lay their eggs at night in early spring in rather large jelly masses under water. Each egg is in two jelly coats, and an individual may lay as many as 225 eggs. The larvae that hatch from these eggs are about a half-inch long and possess no external gills. In about a year the larvae have developed sufficiently to abandon the water and take up life on land, as is normal with their parents. Spotted salamanders are essentially useful creatures, destroying large numbers of insects, slugs, and snails which feed upon our food plants. They secure these from under refuse and in places which cannot be reached by the average insect-destroyer. They are most worthy of protection.

Spotted salamanders make interesting terrarium pets but must be kept in a rather humid atmosphere. If the terrarium has a glass cover, proper atmospheric conditions may easily be maintained.



The two-lined salamander is very common in eastern North America. It spends its time at the water's edge

TWO-LINED SALAMANDER

Eurycea bislineata

SIZE: About 3 inches in length, over half of which is tail; body, small and slender.

RANGE: From New England through southern Canada to Lake Superior, and south to Florida and Louisiana.

The common salamander that one finds under stones in or near brooks in eastern North America is probably the two-lined salamander, which lays its eggs in water and spends its life at the water's edge. This little animal may reduce its length by more than half by the simple process of shedding the tail, if one attempts to interfere with its escape. Two-lined salamanders are very slippery, active creatures. As their name implies, they possess what appear to be two stripes running from the head along each side of the back to half the length of the tail. The back is yellow. The slipperiest football player could learn much from watching a two-lined salamander try to escape. It runs, slides, slips, and jumps, and seems to use any known method of locomotion just so long as it makes progress in the desired direction.

Two-lined salamanders lay their eggs in water in single layers. A single female may lay as many as fifty eggs. The young that hatch from the eggs are at first a honey-yellow color and later become darker. They lack the external gills. There are other somewhat similar and closely related species to be found in the western United States.

DUSKY SALAMANDER

Desmognathus fuscus

SIZE: 4 to 5 inches in length, one-half of which is tail; body, rather stout and cylindrical.

RANGE: Southern Canada to the mountains of South Carolina and Georgia.

This salamander has the head distinctly separated from the body by a neck-fold at the throat. The body is cylindrical but the tail is not. There are fourteen grooves on the sides of the animal. The head is brownish and the body is brownish-gray with very small brown spots. The adults are generally found in wet places near, but not in streams. The creatures can run and wriggle in a most active fashion. They feed upon all sorts of small animal life, particularly insects.

The eggs are laid in late summer at night, and appear like a bunch of about twenty grapes. The strangest thing about them is that they are protected by the female who hides with them in soft earth or under stones near, but not in water. The young remain at the water's edge for about two weeks with their bodies immersed in water and their heads out. In the fall they take to the water as larvae and develop there through the winter. Early the next summer they are ready to leave the water in the adult form, and from then on they live for the most part on land.

[NOTE: There is a form of the red-backed salamander which is not infrequently known as the dusky salamander.]



The adult dusky salamander is usually found living on land near water. It has a very slender body and a distinct head

RED-BACKED SALAMANDER

Plethodon cinereus

SIZE: Greatest length, nearly 4 inches; usually shorter. Body and tail, rather slender.

RANGE: Eastern Canada and the United States east of the Mississippi and in Missouri. Other species occur on the west coast of North America.

The red-backed, or lead-backed, salamander is the one that one frequently finds in the woods under old damp logs or even in stumps. The reason for the two names is a simple one, since apparently there is a color variation which produces some individuals with red backs and others with lead-colored backs. The creatures are gray beneath and have "salt and pepper" colored sides. Red-backed salamanders are most useful as insect-destroyers and they are interesting pets for terrariums. Like the two-lined salamanders, they shed their tails with apparent ease when in danger of being captured.

The life history is interesting because of the fact that the larval stage is spent within the eggs, which are laid in or under some damp log and are protected by the mother. A female may lay from three to twelve eggs, and may lay them in early summer, following a mating activity of the previous fall. The young, when just hatched from the egg, are about an inch long. To keep these salamanders satisfactorily in a terrarium, care must be taken to keep the air reasonably moist. There are a few species to be found on the west coast that have somewhat similar life histories.

Elmer C. Palmer

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PLANTS

THE old method of teaching the subject of plants in nature study was to have the pupil find a subject and try to identify it through a study of structure, organs, etc. This is uninteresting to most children and leads nowhere in particular. However, when we tell the child that plants live in societies or associations just as we do, they immediately become interested in the subject. In the polar regions we find a different kind of people from those in the tropics. They look different, dress differently, and eat differently. The same is true of all animals and plants in the polar regions. We find the polar bear whose white fur blends with the snow, making him less easily detected by his enemies. In the tropics we find such creatures as the alligator, whose appearance in the water is much like that of a log. (There is a good illustration of this point in Vol. V, p. 566.) It is much the same with plants, except that the zoning of vegetation and its relation to surroundings are much more exact and distinct and more easily observed than is the case with animals, because plants as a rule stay in the same place while animals move about.

On a rocky hill exposed to wind and sun, where there is a thin poor soil, we find entirely different plant associations from those which we find on the flood plain, where the soil is rich and where the exposure is less and the moisture more available.

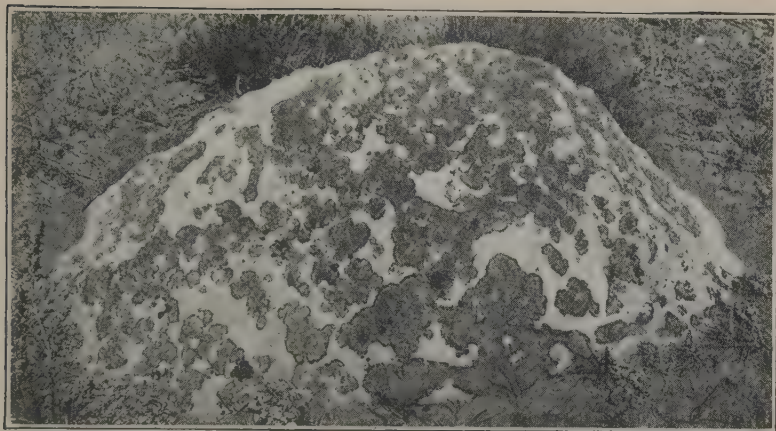
The topographical features of the earth are subject to constant change. Where last year we had a level field, this year we may have a big gully cutting its way back. Plants that thrive on the level field cannot survive on the steep sides of a ravine. Every year the ravine cuts deeper until eventually it cuts down to what we call the ground water—the water which goes into the ground during rains. When the ravine reaches the ground water, seepage begins. New

associations of plants now come into the moist zone. When the ravine cuts deeper, a little stream develops and the stream may eventually become a river. With each change in the topographic features there is a change in the plant societies.

BEGINNINGS OF PLANT LIFE ON ROCKS. The earth in its earliest stages was solid rock. Through the process of weathering, the rock has become soil. Rocks weather by breaking up through changes of temperature and through movements of the earth's crust; they also weather through solution by water and mineral elements mingling with the water, which help to dissolve the rock constituents. In this way the earth has been largely covered over with a mantle of soil.

In addition to the breaking up of rock into soil, either through mechanical means or through solution and by other means, rivers, glaciers, and winds have played their part in covering the earth's surface with soil. Plants which grow in the soil may completely decay, or as is more commonly the case, they may only partly decay, leaving their residue to build up the soil still further. This residue is known as humus. In the forest humus is called "mold," and in the swamp it is called "peat" or "muck." Humus plays a very significant part in the furtherance of plant life.

Even before rocks break up into soil they may be covered with a low type of plant life known as lichens. This is the very first form of plant life to appear on solid rock. Indeed, lichens are the only plants that can actually grow on the rock itself. As one examines a newly exposed rock surface year after year, one will notice that in a few years these tiny plants known as lichens make their appearance gradually and overspread the rock's surface. They are able to grow in so unfavorable a place because they can stand drying up without any injury at all. They can remain quiescent and inactive through long periods of drought, and freshen up and grow again whenever the rains come. Unlike other plants, their roots have the power to penetrate the rock itself. Lichens may be found on almost all rock



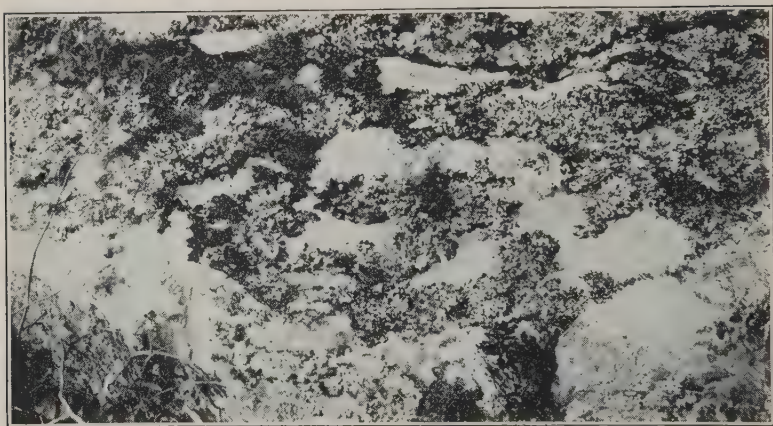
Growth of lichens, the first form of plant life to appear on solid rock

surfaces except in the large city, where the city gases and fumes destroy them very quickly. In spite of their hardiness and ability to resist all degrees of temperature and drought, they are not able to withstand the foul air of our cities.

Lichens may be found on fence posts and trees as well as on rocks. After the lichens have formed a crust over the rock's surface, the seeds of other plants can find lodgment in the lichens or in the soil which they help to create, and so there is a succession of plant life on the rock surfaces. Various forms of herbs follow the lichens and destroy them as they develop.

In addition to the rock surfaces, with their growth of lichens, the crevices of rocks furnish an excellent place for drought-resistant mosses, ferns, and herbs to get a start, even without the help of lichens. And so, after a long period of time, rocks that were formerly bare become clothed with vegetation.

BEGINNINGS OF PLANT LIFE IN THE WATER. Another place where plants may occupy a specific sphere of vegetation is in the water. When soil is first formed it contains no conspicuous vegetation, but close observation shows that



Lichens and mosses in rock crevices

before much time has elapsed, plants begin to appear. Their seeds are brought by birds and winds. After they find a satisfactory place to grow, they develop into plants. Usually the first plants to occupy a new pond are what are known as algae. These plants are threadlike in appearance and form sheets over the surface, often called "pond scums" or "frog spittle." These plants of low organization are the pioneers of water just as lichens and mosses are the pioneers of rocks, and in a similar fashion they prepare the way for higher types of life.

Along with the algae, or shortly after them, appear other plants more highly developed, such as the duckweed, pondweed, and many others. Every year after these plants die down in the autumn, much of the material sinks to the bottom of the pond and there helps to build up the soil and make the pond shallow. Year by year, as the pond becomes shallower through this agency and also through the washing in of soil by the rains, plants of the shallow water succeed those of the deep water. After a certain degree of shallowness is reached, water lilies begin to appear, spreading their leaves over the pond's surface and raising their handsome fragrant flowers to the air. Following these, bul-



Photographs by J. A. Anderson

Peat Moss
Cup Lichen

A Leafy Liverwort
Cord Moss

rushes and cat-tails occupy the still shallower pond whose depth decreases year by year as noted above. The pond becomes a swamp and eventually the swamp develops into a forest. Each of these plant associations of the different stages of the shallowing pond is made up of different plants which are suited to the particular conditions of the stage in which they live.

Rocks and ponds are not the only places in which plants may get a start and develop in the ways just indicated. Along the flood plains of rivers, in ravines, in shifting sands, and everywhere else in nature we find similar stories of plants succeeding one another. Those of the pioneer stages give way to those of the later stages in regular fashion, very much as the white man of our cities today has followed the frontiersman, who in turn followed the Indian who inhabited the forest in time long gone by.

PLANT ANALYSIS

All of nature seems to be a changing panorama, a kaleidoscope, the reading of which as a type of study is vastly more interesting than the study of classification. Classification, however, is necessary. Before one can read the secrets of nature he must know something of the parts that make it up. He must find a way to determine the kind and characteristics of organisms and the elements of nature. It is for this reason that keys have been prepared and descriptions have been written of plants, animals, and rocks. This is not the purpose of nature study, but a necessary background without which the actual reading of the interesting things of nature would be too difficult to attempt.

HOW PLANTS ARE IDENTIFIED. While students of plants eventually learn to identify the different species of the plant kingdom by leaves or stems, the usual keys for the identification of plants are flowers and fruits, because in the last analysis, these are much more dependable and much more easily described. One can readily learn to tell a tree

by its bark or by the character of its branches, but a much more scientific and dependable way of identifying trees, as with other plants, is based on flowers and fruits.

The chief difficulty with such classification, of course, is that flowers and fruits are not always present. Sometimes, indeed, they are very ephemeral. Oftentimes one has the flower without the fruit, or the fruit without the flower. In spite of these difficulties, however, all botanists have agreed for centuries that floral structures are the best guides for determining plant relationships and the best things to be used as a basis for classification.

THE PARTS OF A FLOWER. A representative flower is made up of four sets of organs. The outermost set of leaf-like structures is known as the *calyx*, the individual parts of this being termed *sepals*. Lying within this is the *corolla*, which may or may not be made up of separate leaves called *petals*. If the petals are united into a common structure, the individual parts are still able to be visualized as *lobes*. The calyx and corolla taken together are called the *perianth*. Next within the corolla are the *stamens*, each of which consists usually of a slender stalk, the *filament*, and a terminal structure, the *anther*. The anther contains the particles of dust known as *pollen*, which represents the male element within the flower. At the center of the flower is the *pistil*, or pistils. A simple pistil is composed of a large basal part known as the *ovary* and a slender upper part known as the *style*, which is surmounted by the somewhat enlarged and sticky *stigma*. This represents the female portion of the flower, and the sticky stigma is the organ which receives the pollen grains.

Inside of the ovary are *ovules* which, upon developing, later grow into seeds and these, of course, propagate the species. The more or less broad part of the axis which bears the flowers is known as the *receptacle*. Most flowers are subtended by leaflike organs known as *bracts*, into which the foliage leaves often grade imperceptibly. A group of closely arranged bracts is called an *involucre*.

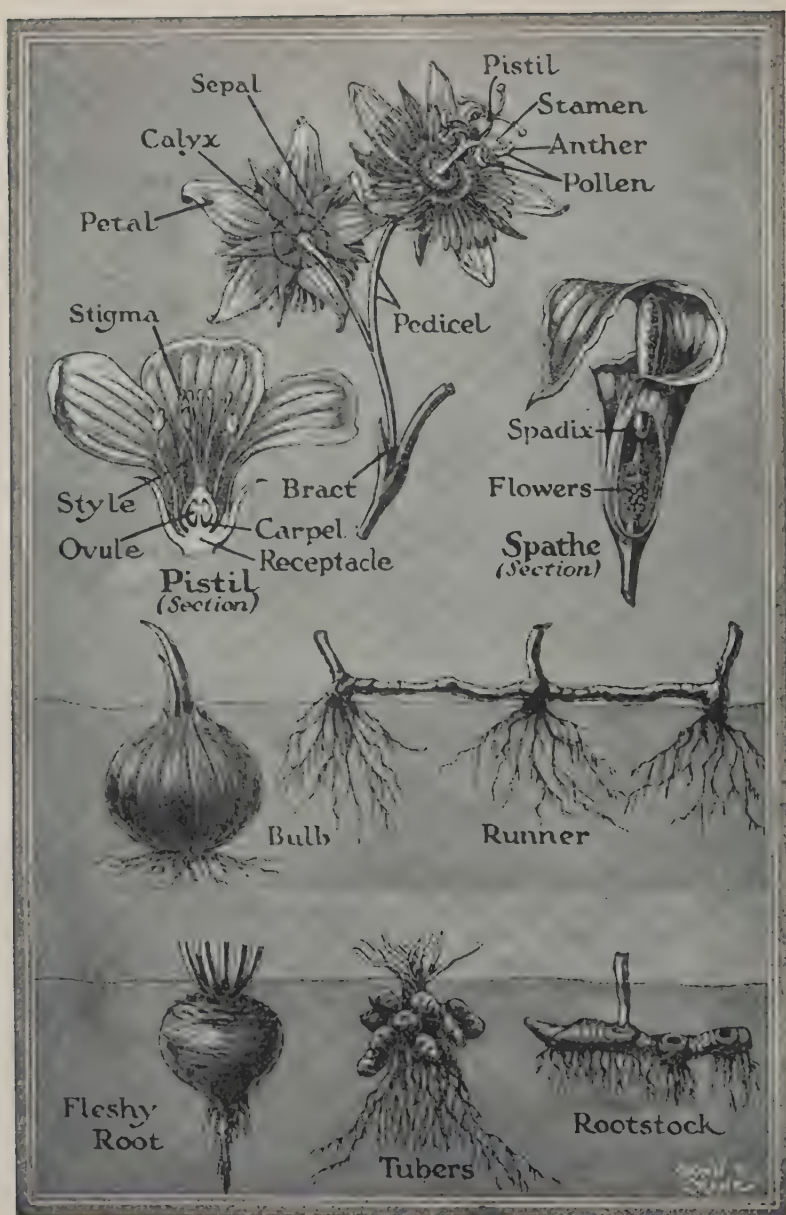


PLATE A



PLATE B

THE TYPES OF INFLORESCENCE. Although flowers are often solitary, they are more commonly grouped into an inflorescence. If the flower has no stalk, it is called *sessile*. The most common types of inflorescence are the following:

A *spike* is a flower cluster with a rather long axis, along which the flowers are sessile, or nearly so, as in the plantain.

Catkin is the name given to a scaly sort of spike, found on such trees as the willow and birch.

Spadix is the name given to a peculiar, fleshy spike or head, which occurs in the jack-in-the-pulpit. It is usually surrounded by a big enveloping leaf known as the *spathe*.

A *head* is a roundish cluster of sessile flowers, such as occur in the sycamore and red clover.

A *raceme* is like a spike except that each flower has its own stalk instead of being sessile, as in the chokecherry or currant.

An *umbel* is a type of flower in which the pedicels all come apparently from the same point and spread out like the rays of an umbrella, as in the wild carrot.

A *panicle* is a compound flower cluster, that is, one with numerous branches which also bear flowers in greater or less numbers.

A *cyme* is commonly a flat-topped flower cluster, the blossoms in terminal buds, the upper ones blossoming first instead of last as in the raceme and spike.

Flowers are known as *perfect* if they contain both male and female organs in the same flower. They are known as *imperfect* if the male and female organs are in separate flowers. In the latter case they are called *monoecious* if the male and female organs are in different flowers on the same plant, as in the oak; and they are called *dioecious* if the male and female organs are found on different plants, as in the cottonwood and willow.

Flowers are known as *regular* or *symmetrical* if the members of a division, such as the corolla, are alike, as in the apple; they are called *irregular* if some of the members of a division, such as the corolla, are different from each other, as in the violet, columbine, or lady's-slipper.

WOODLAND FLOWERS OF EARLY SPRING

BUTTERCUP OR CROWFOOT FAMILY

Ranunculaceae

This family consists for the most part of perennial herbs and includes many of the most beautiful spring flowers of our woodlands. The floral parts are all distinct, and the calyx is free from the ovary. The sepals vary in number from three to fifteen, as do the petals, although often there are no petals at all. The stamens and pistils are numerous. The sap is acrid and sometimes poisonous. In addition to the four species that follow, these pages also include the columbine (p. 501), the marsh marigold (p. 506), and the clematis (p. 523), which likewise belong to this family.

The buttercup family includes a great number of plants that are medicinal or poisonous, many species having both of these attributes. Among the more important of these are the goldenseal, goldthread, hellebore, baneberry, bugbane, larkspur, and aconite. The larkspur is one of the most dangerous and destructive of the poisonous plants on the western stock ranches. Many of the buttercup family are extremely ornamental and are much cultivated; in this connection we may especially note larkspur, aconite (or monk's hood), peony, clematis, and anemone.

HEPATICA OR LIVER LEAF

PLATE 2

Hepatica triloba and *H. acutiloba*

DESCRIPTION: Low plant with leaves having three liver-shaped lobes, and white, pink, blue, or purplish flowers.

DISTRIBUTION: In woods, from Nova Scotia to Florida, Missouri, and Minnesota.

In this beautiful plant the leaves are heart-shaped and three-lobed; they persist through the winter and are often beautifully colored underneath. The new leaves of the season develop after the flower, and like the latter are very hairy. The common name, liver leaf, is given because of the liver-like aspect of the leaves. In ancient times, when it was believed that human ills could be cured

by plants that suggested the disease or the organ affected, the liver leaf was thought to cure diseases of the liver.

The hepatica is one of the earliest of spring flowers in upland woods and ravines, breaking its way through the covering of dead leaves in late March or early April. The flower color varies from white and various shades of pink to the deepest blue, and the flowers are often fragrant. There are no petals, but the sepals, which are six to twelve in number, are colored like petals. Just below the corolla is an involucre of three sepal-like bracts. The fruit consists of achenes arranged in small loose heads. There are two species which may be called the round-leaved hepatica and the acute-leaved hepatica, differing from each other chiefly in the shape of the leaf indicated by the suggested names. The round-leaved species is rather more common in the eastern part of the country and occurs also in Europe. The acute-leaved species is the more common in the West.

ANEMONE

PAGE 487

Anemone

DESCRIPTION: Perennial herb with compound leaves and flowers most commonly white or purplish.

DISTRIBUTION: Widely distributed throughout eastern North America.

The anemone resembles the hepatica in its petal-like sepals and in its absence of true petals. It differs, however, in its compound leaves and in the presence of a leaflike involucre of opposite or whorled leaves which are remote from the flower. There are several common species, the one most characteristic of early spring being the windflower or wood anemone (*Anemone quinquefolia*) found in upland woods. In this species each plant has a single delicate purplish nodding flower. Later on, one may see in meadows and prairies the beautiful pure white flowers of the meadow anemone (*Anemone canadensis*), a much larger and coarser plant than the preceding. Still later in the season, usually in summer, one may find the Virginia anemone (*Anemone virginiana*), also a white-flowered species which has conspicuous cottony fruits in the autumn. This species is rather common in dry open woods.

Perhaps the most beautiful of our native anemones is the pasque flower of the prairie (*Anemone patens*), which ranges from Illinois



PLATE I.

Rue Anemone
flower and fruit
False Solomon's Seal

© Painted from living plants expressly for THE CLASSROOM TEACHER

Dutchman's Breeches

Blue Violet
flower and fruit
White Trillium



PLATE 2.

Hepatica
Buttercup

© Painted from living plants expressly for THE CLASSROOM TEACHER

Bloodroot
flower and fruit

Bellwort
Yellow Violet
flower and fruit

MEESON

westward. This plant is one of the harbingers of spring in the prairie country, sending up its large and beautiful blue to purple flowers, an inch to an inch and a half in length, in the very earliest spring, before the leaves appear. The whole plant is clothed with beautiful silky hairs. The fruit, which comes later, is also very showy, the carpels being provided with tails two inches in length, disposed in large showy cottony heads. This anemone is the state flower of South Dakota. Closely related species of large-flowered anemone are found in the western mountains and also in Europe. Several showy anemones are cultivated in gardens and are very ornamental hardy perennials.

RUE ANEMONE

PLATE 1

Anemonella thalictroides

DESCRIPTION: Low perennial with compound leaves and white or pinkish flowers in umbels.

DISTRIBUTION: In woods from southern New Hampshire to Minnesota, Kansas, Tennessee, and northwest Florida.

The rue anemone resembles the true anemone and the hepatica in its petal-like sepals and in its absence of true petals, and also in the possession of achenes. It differs from both of the preceding, however, in its umbellate flowers and in its clustered, tuberous roots. It is one of the beautiful plants of early spring in dryish upland woods.

BUTTERCUP OR CROWFOOT

PLATE 2

Ranunculus

DESCRIPTION: Annual or perennial herbs with alternate leaves; flowers, usually yellow.

DISTRIBUTION: Widely distributed throughout most of North America.

There are many species of buttercups and they may be regarded as the most typical plants of the buttercup family. Buttercups are found almost throughout the Northern Hemisphere, even to the arctic and alpine snows. The buttercup differs from the preceding genera in having five petals, usually yellow, and five green sepals. While the fruit is an achene, it is flatter and of different shape than in the rue anemone. The achenes are usually disposed in globular

or cylindrical heads. The leaves are alternate. Several species of buttercup have very acrid juice. The species differ in hairiness, those of swamps and moist woods being largely smooth and those of drier situations largely hairy.

The most characteristic woodland buttercup of early spring is *Ranunculus septentrionalis*, which has large showy flowers and creeping stems. This is especially characteristic of moist woods. The small-flowered buttercup (*Ranunculus abortivus*) occurs with the preceding species in time, but in rather drier situations. A third species may be called the upland buttercup (*Ranunculus fascicularis*). This also flourishes in early spring, growing most successfully on dry sunny hillsides. *Ranunculus bulbosus* and *Ranunculus acris* are two species introduced from Europe, common especially in the eastern states. *Ranunculus delphinifolius* and *Ranunculus aquatilis* are extremely showy aquatic buttercups of later spring; the second of these differs from all the preceding species in having white flowers. Several species of buttercup are cultivated for ornament, some of them having double flowers.

MEADOW RUE

PAGE 487

Thalictrum

DESCRIPTION: Erect perennial herbs with small greenish-white or purplish flowers.

DISTRIBUTION: Various species widely distributed throughout North America.

The meadow rue, like the marsh marigold of the same family, does not have petals, their place being taken by petal-like sepals. It has clusters of small greenish-white or purplish flowers which are rather inconspicuous, but the general effect of these plumelike clusters and the divided leaves is very graceful. The flowers of some species are very fragrant.

Early meadow rue (*Thalictrum dioicum*) is the first of these plants to appear in the spring, coming with the earliest blossoming flowers in April. It has thin light green leaves and greenish-white or purplish flowers. *Thalictrum dasycarpum* is commonly called the purplish meadow rue because its stems are purplish and its flowers are purple or purplish-white. The early meadow rue grows in woods rather than in meadows, but the other species of this genus usually frequent meadows or low grounds along streams.

HEATH FAMILY

Ericaceae

The members of this family are mostly shrubby and usually are evergreens. The family as a whole is especially characteristic of acid soils in temperate or arctic-alpine habitats. Almost all the members of the heath family have showy flowers and many of the species are cultivated for ornament. The flowers are regular and often bell-shaped, and the corolla usually has its petals united. The stamens are of the same number as the corolla lobes, or twice that number, and the anthers are appendaged or open with terminal pores. Apart from the trailing arbutus, a description of which follows, other noteworthy plants of this family are the blueberry (p. 585), rhododendron (p. 574), laurel (p. 574), wintergreen (p. 512), Indian pipe (p. 511), cranberry, huckleberry, heather, shinleaf, and bearberry.

TRAILING ARBUTUS

PAGE 487

Epigaea repens

DESCRIPTION: Trailing plant with evergreen leaves and clusters of pink flowers.

DISTRIBUTION: In sandy woods or rocky soil from Newfoundland to Saskatchewan, Wisconsin, Michigan, Kentucky, and Florida.

The trailing arbutus is the state flower of Massachusetts and from the days of the landing of the Pilgrims has been one of the favorite plants of the United States. According to legends handed down from these early days, this was the first flower to blossom after the landing in the bleak days of winter. It was the first sure indicator of approaching spring, and the grateful Pilgrims named it the Mayflower, after the vessel in which they came. Other reasons for the high regard in which this plant is held are its great beauty, its delicious fragrance, and its extremely early appearance in late March or early April.

The trailing arbutus grows in rather open woods, especially under oaks and pines. It is an evergreen trailer with heart-shaped

leaves and deliciously fragrant pink flowers. It grows in dry acid soil and much prefers this situation to good garden soil. Many unsuccessful attempts were made to cultivate this beautiful plant, the lack of success being due probably to the fact that it was grown in good soil instead of in the poor soil which it likes. Many successful cultivations of the plant have recently been made by giving to it the kind of soil conditions characteristic of its native habitat. Unfortunately, this beautiful plant is becoming very rare, and in some places it has become extinct. This tragedy is due to too abundant picking. Too often, most of the plant is rooted up when the flowers are picked. This is especially injurious to the trailing arbutus, because of its extremely slow growth. There is no plant in our entire flora that more deserves conservation than the trailing arbutus.

POPPY FAMILY

Papaveraceae

All members of this family have either milky or colored juice. The flowers are regular with the parts in twos or fours. The sepals are usually two in number and are very ephemeral, falling off for the most part when the flower opens. The stamens are numerous. The leaves are alternate and without stipules. This family includes several very handsome flowers often seen in gardens, such as the common poppy, famous not only for its beauty but also as a source of opium, the golden California poppy, and the celandine poppy. The bloodroot is the only common species of this family native to eastern North America.

BLOODROOT

PLATE 2

Sanguinaria canadensis

DESCRIPTION: Low perennial with thick root, having red sap, deeply lobed leaf, and single large white flower.

DISTRIBUTION: In rich woods from Nova Scotia to Manitoba and Nebraska, south to Florida, Alabama, and Arkansas.

Its blood-red sap gives this plant its name. Its single white starlike bloom is very beautiful, and is much loved because it is

one of the first flowers to appear in the woods in spring. Like all members of the poppy family, the flower is very fragile. When the bud shoots up from the ground it is protected by a leaf wrapped around it. The petals are from eight to twelve in number, pure white in color, and are crumpled in the bud. Each plant has only one flower. The sepals fall off so readily that they often elude observation, and the petals also are very fleeting, so that it is unwise ever to pick the flowers of this plant for bouquet purposes. The stamens, which are about twenty-four in number, form a brilliant golden mass. The beautiful black and shiny seeds are formed in a one-celled elongated pod. The reddish sap in former times was thought to be a remedy for diseases of the blood. The Indians used it in their war paint. Even now the root is sometimes used in the treatment of bronchial affections.

FUMITORY FAMILY

Fumariaceae

This family is closely related to the poppy family, from which it differs most conspicuously in having a watery juice instead of a milky or colored juice. Its members are delicate and beautiful herbs with compound leaves and irregular flowers, and in these respects also it differs from the plants of the poppy family. The best-known member of the fumitory family is Dutchman's breeches.

DUTCHMAN'S BREECHES

PLATE 1

Dicentra cucullaria

DESCRIPTION: Low plant with delicately cut leaves and odd-shaped white or pinkish flowers tipped with yellow.

DISTRIBUTION: In rich woods from Nova Scotia to Minnesota, North Carolina, Missouri, and Kansas.

This very well-known plant of early spring is quickly recognized through its odd-shaped flowers, which resemble miniature pantaloon, arranged one above the other on an upright stem. The shape of the flowers, of course, gives this species its common name. The fragile blossoms are white, although sometimes with a pinkish tint, and are tipped with yellow. The lacelike leaves are almost as

daintily as the flowers. The stem comes from a sort of granulate bulb, which is, in reality, a cluster of grainlike tubers crowded together.

Closely related to this species is the squirrel corn, sometimes called turkey corn (*Dicentra canadensis*). The leaves of this plant are very much like those of Dutchman's breeches, so much so that it is difficult to tell the plants apart when they are not in flower, although the leaves of squirrel corn are often somewhat closer and less lacelike. The underground parts, however, are very different, this plant having tubers which look like yellow grains of corn strung on a string and account for the common names squirrel corn and turkey corn. The flowers also are easily distinguished from those of Dutchman's breeches, being shaped more like a heart, and of a greenish-white color tinged with rose. The flower has the fragrance of the hyacinth and is sometimes called wild hyacinth. This plant has much the same range as Dutchman's breeches, though in many sections it is much less common.

PURSLANE FAMILY

Portulacaceae

The purslane family consists of herbs having for the most part succulent leaves. The flowers are regular and unsymmetrical; that is, the sepals may be fewer than the petals. These flowers open only in the sunshine, and usually last but one day. In addition to the spring beauty, the garden portulaca, so commonly cultivated, the common weed purslane, or pusley, and the beautiful bitterroot (the state flower of Montana) are members of this family.

SPRING BEAUTY

PAGE 487

Claytonia virginica

DESCRIPTION: Perennial herb with opposite lance-shaped leaves and white or pink flowers.

DISTRIBUTION: In moist woods from Nova Scotia to Saskatchewan and Montana and south to Florida and Texas.

The spring beauty is one of the first flowers of spring, and in many sections of the country is one of the most abundant of all



Photographs by E. L. Cressall and C. R. Shoemaker

Courtesy, Wild Flower Preservation Society

Wood Anemone

Early Meadow Rue

Adder's-tongue Lily

Trailing Arbutus

Spring Beauty

spring flowers, sometimes almost covering the ground in open woods. The starlike flowers have five petals and usually range in color from white to rose with prominent pink or deeper-colored veins. The sepals are two in number. Several of the flowers usually are arranged, one above the other, on the same side of the slender stem. As in other members of this family, the flowers are very delicate, and close at night or on cloudy days, and even when touched. Each plant has two grasslike succulent leaves. The plant arises from what is known as a *corm*, a solid bulb differing from a tuber in its erect growth.

LILY FAMILY

Liliaceae

This is a very large and important family of plants, containing in all more than two thousand species and including a large number of useful and ornamental plants. The lily family is very conspicuous in the spring flora, especially in rich woods. In addition to the varieties mentioned below, this family includes most of the plants commonly known as lilies, such as the Easter lily, the tiger lily, the day lily, and the lily of the valley. All of these are well-known and much-prized ornamentals frequently seen in cultivation. Other well-known cultivated ornamentals of this family are the tulip, the hyacinth, the snowdrop, and the star-of-Bethlehem. To this family belong also several important economic plants such as the onion, leek, garlic, and asparagus. The yucca, so familiar in the American desert, and the aloe, equally characteristic of the African desert, are also members of this important family.

Most of the members of the lily family arise from bulbs, but some, such as the Solomon's seal, arise from rootstocks. In addition to the plants described here, members of this family are the wild lilies of the valley (p. 498) and the Turk's-cap lily (p. 521). Two summer plants which have some resemblance to the lily in their flower, but belong to other families, are the spiderwort (*Tradescantia*) and the arrowleaf (*Sagittaria*). This family includes mostly herba-

ceous plants, the only common woody member being the greenbrier, or cat brier (*Smilax*). The flowers are regular and symmetrical, almost always six-parted. The petals and sepals, which together constitute the perianth, are free from the three-celled ovary.

BELLWORT

PLATE 2

Uvularia

DESCRIPTION: Perfoliate leaves; yellowish bell-shaped flowers.

DISTRIBUTION: In rich woods from Quebec and Ontario to Florida and Mississippi.

The bellwort is a plant with perfoliate leaves, that is, the stem sometimes appears to run through the leaf blade (Latin *per*, through, and *folium*, leaf). The flowers are small, drooping, and bell-shaped (as the name "bellwort" indicates), and are pale yellow in color. There are two species in our flora which differ only in small details.

ADDER'S-TONGUE LILY OR DOGTOOTH VIOLET

PAGE 487

Erythronium

DESCRIPTION: Leaves, oblong-lance-shaped, mottled; flower, white or yellow on scape 6 to 9 inches high.

DISTRIBUTION: In rich woods. Yellow adder's-tongue, from Nova Scotia to Ontario and Minnesota and south to Florida, Arkansas, and Nebraska; white adder's-tongue, from Ontario to Minnesota and south through Florida, Tennessee, and Texas.

Though commonly known as the dogtooth violet, this plant is not a violet at all, but a true lily. Hence the name adder's-tongue lily would seem preferable as a common name. The leaves are two in number, and are long and lance-shaped, and usually mottled with brown. Quantities of food are stored in the bulb, thus enabling this plant to send up its leaves and flowers in very early spring, before the trees leaf out and cut off the sunshine from the forest floor. The flowers are rather large and nodding. The fruit is a many-seeded capsule.

There are two common species of adder's-tongue lily, the yellow (*Erythronium americanum*) and the white (*Erythronium albidum*). The yellow species is the more common one in the East, and the

white the more common one in the West. Both of the adder's-tongues spread widely by underground stems and form great patches of plants in rich woods. In any patch of either species only a few of the plants blossom at any one season, since they have to have a certain period of growth before they are mature enough to bloom.

SOLOMON'S SEAL

PAGE 491

Polygonatum

DESCRIPTION: Perennial herb with smooth clasping leaves and bell-shaped greenish-white flowers in the axils of the leaves.

DISTRIBUTION: In rich woods throughout most of the eastern United States and Canada. The great Solomon's seal occurs also in the western mountains.

This plant has gracefully curving stalks which bear smooth, nodding, bell-shaped greenish-white flowers, usually hanging in twos from the leaf axils. The flowers are followed in summer or autumn by showy blue or black berries, somewhat resembling blueberries in general aspect.

The Solomon's seal arises from an elongated rootstock, and the name probably comes from the fact that there are seal-like impressions on the rootstock wherever the erect, flower-bearing stems have fallen off. Also, when the rootstock is cut across, it somewhat resembles a seal. The old herbalists used to believe that this plant had the power of healing wounds and that it was a cure for almost every ill.

There are two species in our flora, differing mainly in size—the small Solomon's seal (*Polygonatum biflorum*) and the great Solomon's seal (*Polygonatum commutatum*).

FALSE SOLOMON'S SEAL

PLATE 1

Smilacina

DESCRIPTION: Similar to Solomon's seal, but with flowers in a cluster at end of stem.

DISTRIBUTION: Widely distributed throughout the eastern United States and southern Canada.

The stem and leaves of this plant are similar to those of Solomon's seal except that the rootstock is without the conspicuous seals and the flowers are borne in a cluster at the end of the stem.



Lower photographs by E. L. Crandall

Courtesy, Wild Flower Preservation Society

Small Solomon's Seal

Small Solomon's Seal
fruit

Jack-in-the-Pulpit

Blue Phlox

These flowers are white and sometimes fragrant. The berries, which appear in late summer or in the autumn, are greenish or yellowish, and are speckled with brown or with red. They are very beautiful.

There are two common species in our flora, *Smilacina racemosa*, often called the false spikenard, and *Smilacina stellata*. The false spikenard has numerous flowers and a terminal panicle, and the other species has larger and fewer flowers. Both species arise from long rootstocks, and occur commonly in rich woods.

TRILLIUM

PLATE 1

Trillium

DESCRIPTION: Low perennial herb with simple stem bearing 3 leaves and a large flower with 3 petals and 3 sepals.

DISTRIBUTION: Chiefly in rich woods from Quebec to Ontario and Minnesota and south to North Carolina and Missouri.

Trillium is a well-known and widely distributed genus of the lily family. It gets its name from the Latin name for "three," since the parts occur in threes—three leaves, three sepals, three petals, six stamens in groups of three each, and a pistil in three parts. In addition to the name trillium, which is both the technical and the common name, this plant is often called wake-robin and birthroot. The latter name perhaps has reference to its early appearance in the spring.

Perhaps the most beautiful and best-known member of the genus is the large white trillium (*Trillium grandiflorum*) which grows in rich woods. The earliest of the trilliums is the dwarf white, or snow, trillium (*Trillium nivale*), which is much more local in its distribution, occurring only from Pennsylvania and Kentucky to Minnesota and Iowa. It is called the snow trillium because it comes up so early in the spring. The Latin name *nivale* has the same significance. There are two species of nodding white trillium frequently found in the central United States, and also two species of red trillium (*Trillium recurvatum* and *Trillium erectum*). The last-named species has ill-scented purplish-red flowers with yellow centers. It caters to the flesh flies rather than to the bees and butterflies, as do the other trilliums. All species of trillium arise from tuber-like rootstocks, and most of the species flourish best in rich woods.

VIOLET FAMILY

Violaceae

This is a small family, and most familiar through the genus *Viola*, which includes all of our common well-known violets, and also the much-loved and widely cultivated pansy. All the violets have irregular flowers, and are rather showy.

VIOLET

PLATES 1, 2

Viola

DESCRIPTION: Leaves, generally heart-shaped, sometimes divided; flowers, irregular, 5-petaled, most commonly violet-blue, sometimes white or yellow.

DISTRIBUTION: Widely distributed throughout most of North America.

Perhaps the best known of the violets is the common blue violet (*Viola cucullata*) which appears in early spring in moist rich woods and meadows. In addition to the well-known showy flowers of spring, the common blue violet also has much less well-known underground flowers in summer, which are not showy but which are very important because they are the main seed-producing flowers of this plant. The seed-pods are three-lobed, each one of these lobes dividing lengthwise, with a double row of seeds within. Four states have made the violet the state flower. They are Illinois, Rhode Island, Wisconsin, and New Jersey.

In addition to the common blue violet, other interesting members of this genus are the bird's-foot violet (*Viola pedata*), which is especially common in open, sandy woods. A very beautiful form of the bird's-foot violet, known as the pansy violet, has dark blue upper petals and pale blue lower petals. Another much-loved violet is the sweet white violet (*Viola blanda*), one of the most fragrant of our native flowers. This species occurs in swampy woods. The yellow violets (*Viola pubescens* and *Viola scabriuscula*) are common in rich woods along with the common blue violet, and the arrow-leaf violet (*Viola sagittata*) is rather common in sandy soil. A number of other species of violet are found in our flora, and are characteristic of many different types of soil conditions. Some species like sweet soil and others are just as fond of sour soil.

ARUM FAMILY

Araceae

The peculiar thing about the arum family is that what appears to be the flower is not the flower at all. The real flowers are very tiny and are clustered on a fleshy spike called a *spadix*, which is usually surrounded by a hoodlike leaf known as a *spathe* (see Plate A). The plants of this family have an acrid or pungent juice. The family is a large one, most of its members belonging to tropical lands. Several of them, however, are found in North America. In addition to the jack-in-the-pulpit, other native species of this family are the skunk cabbage (see p. 506), the sweet flag or calamus, and the green dragon. A very beautiful cultivated plant is the calla, or the calla lily. Several plants in this family are useful to man. Among these may be noted the sweet flag, whose rootstock is used in medicine.

JACK-IN-THE-PULPIT

PAGE 491

Arisaema triphyllum

DESCRIPTION: Low perennial herb with green spathe and spadix.

DISTRIBUTION: In moist rich woods from New England to Minnesota and southward to the Gulf of Mexico.

In this plant, it is easy to see the resemblance to a preacher in his pulpit. Jack, the preacher, is a green, fleshy spadix, with many little yellow flowers clustered about him. He stands in the pulpit, which is a flaring spathe, also of green with stripes of darker green or purple. The plant is sometimes called Indian turnip, because of its turnip-shaped corm. When chewed, this corm causes a severe biting and burning sensation in the mouth which often lasts for some time. After being cooked, however, the corm is more or less palatable, and was used for food by the Indians.

In the fall the jack-in-the-pulpit bears a cluster of showy scarlet berries which are eaten by many of the game birds. The leaves of this plant are usually two in number, and are divided into three pointed leaflets. Usually the plants are dioecious, that is, the male and female flowers are on separate plants. While the spathe is

much alike on the male and female plants, the spadix is very different. Below ground the main corm of the jack-in-the-pulpit gives off smaller corms, and the plant spreads by this means as well as by seeds.

An interesting relative of the jack-in-the-pulpit is the green dragon (*Arisaema dracontium*). It differs from the jack-in-the-pulpit in having a solitary leaf divided into from seven to eleven leaflets instead of three leaflets. Another difference is that the spadix tapers to a long and slender point far beyond the spathe.

POLEMONIUM OR PHLOX FAMILY

Polemoniaceae

The polemonium family consists of herbs having alternate or opposite leaves and regular five-petaled flowers. There are about two hundred species, some of which have very showy flowers. In addition to the several species of phlox, which are the most familiar members, the family includes the polemonium or Greek valerian, the gillias, and the colomias.

PHLOX

PAGE 491

Phlox

DESCRIPTION: Perennial herbs with opposite, often lance-shaped leaves and clusters of white, pink, rose, purple, or blue flowers.

DISTRIBUTION: Widely distributed, especially throughout the central United States.

The genus *Phlox*, some members of which are called wild sweet William, includes some favorite plants, both in nature and in cultivation. One of the best-known species is the blue phlox (*Phlox divaricata*) which is common in rich woods in spring. The leaves in this and other species of phlox are opposite. In addition to the blue phlox just named, there may be mentioned *Phlox paniculata*, the common perennial phlox of the garden, which is native from Pennsylvania to Illinois, Kansas, and southward; the smooth phlox (*Phlox glaberrima*); the hairy phlox (*Phlox pilosa*); and the moss pink (*Phlox subulata*).

WOODLAND FLOWERS OF LATE SPRING

GERANIUM FAMILY

Geraniaceae

The geranium family consists of herbs with lobed or divided leaves, and perfect, regular, five-parted flowers. It is especially characteristic of South Africa, from which our showy cultivated geraniums have come. About the only common representatives of this family in our flora are species of the genus *Geranium*, although the stork's-bill (*Erodium*) is sometimes found as a weed, especially in the arid West. It was a study of one of the members of the geranium family that led the great German botanist, Sprengel, to the conclusion that flowers are fertilized by the transfer of pollen through the agency of insects which visit the flowers in search of nectar. Sprengel was the first to point out the close relationship between plants and the insect world.

WILD GERANIUM OR CRANE'S-BILL

PAGE 499

Geranium maculatum

DESCRIPTION: Erect hairy stem, 1 to 2 feet high; pink or lavender flowers.

DISTRIBUTION: In rather dry, open woods from Maine and Ontario to Manitoba, and south to Georgia and Alabama.

The two names of this flower mean about the same, since the word "geranium" comes from the Greek word for crane. The name has reference to the long beak of the fruit, which resembles the bill of a crane. When the seeds are ripe, the pod opens and shoots them out for some distance. Thus the plant becomes distributed over an increasing area. The common wild geranium has an erect, slender, hairy stem bearing five-parted leaves and graceful flowers of pink or lavender. The root contains quantities of gallic acid and tannic acid, which give it a puckery taste. It is used in medicine as an astringent. In addition to the common wild geranium, the herb Robert (*Geranium robertianum*) is especially common in rocky woods in the eastern states. It is distinguished by a very character-

istic pungent odor. A somewhat similar species, but without the characteristic odor, is the Carolina geranium (*Geranium carolinianum*), which is especially characteristic of poor soil.

BARBERRY FAMILY

Berberidaceae

This family is composed partly of shrubs and partly of herbs whose relationship to each other is quite often not particularly obvious. It includes the barberry, the Oregon grape (the state flower of Oregon), the blue cohosh, and the twinleaf, as well as the May apple, which is described here. The fruit of some species is used in making jellies noted for their beautiful color and distinct flavor. Both barberry jelly and May-apple jelly are famous. The yellow roots of some species are used in dyeing, and the bark of other species in tanning.

MAY APPLE OR MANDRAKE

PAGE 499

Podophyllum peltatum

DESCRIPTION: Perennial herb, 12 to 20 inches high, with white cup-shaped flowers and plumlike fruit.

DISTRIBUTION: Especially characteristic of rather dry, open woods from western Quebec to Minnesota and south to Florida and Texas.

The May apple gets its name from its fruit, which resembles a plum and is yellow when ripe. The name "May apple," however, is a misnomer, because the fruit commonly does not mature until July or August. The fruit is edible, and even delicious, and from it a splendid jelly may be made. The rest of the plant is regarded as poisonous, and is very important in medicine. The name "mandrake" comes from the fancied resemblance of the root to the body of a man.

There are two kinds of leaves. One is a large umbrella-like leaf with seven to nine lobes. These leaves are borne on the flowerless stems. The flowering stems bear two one-sided leaves, and a nodding, waxy white flower at the fork. This flower is saucer-shaped and is very fragrant. It is protected more or less from view by the

overshadowing leaves. Its petals are from six to nine in number, and the stamens twice as many. The May apple grows in patches which spread rapidly by underground stems.

LILY FAMILY

Liliaceae

The general characteristics of the lily family are given under the heading, Woodland Flowers of Early Spring (see p. 488).

WILD LILY OF THE VALLEY

PLATE 3

Maianthemum canadense

DESCRIPTION: Leaves, ovate; flowers, white, in a terminal cluster.

DISTRIBUTION: In moist woods from Newfoundland to Manitoba and south to North Carolina and Tennessee.

This plant, although called the wild lily of the valley, more nearly resembles the false Solomon's seal, to which it is closely related, than it does the lily of the valley. It might well be called the two-leaved false Solomon's seal. The small white flowers are borne in a beautiful terminal cluster and are noteworthy in having the parts in fours instead of in threes or sixes. In this respect it stands alone in the lily family. The berries are pale red and speckled like those of the false Solomon's seal.

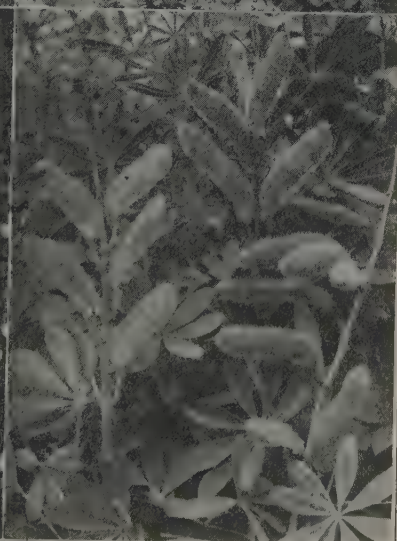
PULSE FAMILY

Leguminosae

This is one of the largest and most important of all families of plants. It includes great numbers of our cultivated plants, such as the pea, bean, peanut, clover (see p. 520), and alfalfa. To this family also belong a number of trees which are especially common in the tropics. The pulse family is notable among all families of plants in that its roots have little tubercles which contain bacteria that provide the plant with the nitrogen it needs. All plants require nitrogen, but



Upper right photograph by E. L. Crandall



Courtesy, Wild Flower Preservation Society

Wild Geranium

Wild Lupine

May Apple

Wild Lupine
fruit

the members of this family are peculiar in that they have this special provision for obtaining it. It is for this reason that clover, cow peas, alfalfa, soy beans, and other herbaceous members are often plowed under so as to enrich the soil in nitrogen for other crops. The flowers of the pulse family are very characteristic and they somewhat resemble the butterfly in shape. This is of special significance in connection with fertilization by insects, particularly by bees. When a bee alights on the lip of the flower, the stamens and petals are exposed and transfer of pollen to the stigma may be made by the visiting insect.

In addition to the plants above noted, various ornamentals of our gardens belong to this family, especially the sweet pea and the beautiful vine, wistaria. The pod of the pulse family is almost as characteristic as the flower. This particular type of pod is called a *legume*, from which the family gets its scientific name.

LUPINE

PAGE 499

Lupinus perennis

DESCRIPTION: Plant about a foot high; leaflets, 7 to 11; flowers, blue, rarely varying to white, on a long slender spike.

DISTRIBUTION: In dry, sandy, sour soil, from Maine to Minnesota and south to Florida and Louisiana.

This beautiful and very showy plant has extremely characteristic wheel-shaped leaves with seven to eleven narrow leaflets. The flowers are purplish-blue and usually appear in May. The leaves turn toward the sun and close up at night, as do those of many of the other members of the pulse family. The word "lupine" comes from the Latin word for wolf. This name was applied in ancient times because it was noticed that the lupine thrives in very poor soil. It was therefore thought that it robbed the soil of its fertility much as wolves rob farmers of their animals. As a matter of fact, the lupine does not rob the soil of its fertility, but, as explained above, it adds greatly to it, through the accumulation of nitrogen. When ripe, the seed pods burst and shoot the seeds for some distance. A southern species of lupine, known as the bluebonnet (*Lupinus texensis*), is the state flower of Texas.

BUTTERCUP OR CROWFOOT FAMILY

(See Page 479)

COLUMBINE

PLATE 3

Aquilegia canadensis

DESCRIPTION: Plant, 1 to 2 feet high, with compound leaves and showy inverted flowers.

DISTRIBUTION: In rocky woodlands from Nova Scotia to Manitoba and south to Florida and Texas. The Colorado columbine ranges from Montana to Mexico.

This is one of the most graceful and beautiful of our wild flowers. Its long jewel-like blossoms hang in an inverted position on long threadlike stems, and they dance about gayly in the breeze. The name "columbine" comes from the Latin word for dove, but the significance of the name is somewhat doubtful. The scientific name comes from the Latin word for eagle, and its significance, too, is doubtful, although the spurs of the flower somewhat resemble an eagle's claws.

In the columbine the nectar is abundant and is hidden far back in the little spurs, or cornucopias, where it is obtainable only by insects with long mouth parts. This is one of the most striking cases of flower specialization in the plant kingdom, the structure of the flower being adapted for fertilization only by certain special insects which come to get the honey. The common wild columbine is red without and yellow within. The Colorado columbine (*Aquilegia caerulea*) is blue in color, and is the state flower of Colorado. Some varieties of this western columbine are lavender and white.

In addition to the columbines above noted, there are several other species of columbine, native to the Old World, which are much cultivated in perennial gardens.

ORCHID FAMILY

Orchidaceae

The rarest and most costly flowers in the world are included in this family. Many collectors have suffered dangers and hardships searching for unusual specimens in the tropical

forests. Most people believe that orchids are exclusively tropical and grow only on the branches of trees. However, we have in eastern North America quite a number of species of orchid which root in the soil as most plants do and which often are showy and beautiful. Most species, however, are rare, and the flowers should not be picked.

The most familiar of our native orchids are the lady's-slippers, the pogonias, the grass pinks, the ladies'-tresses, and the fringed orchids. Though the orchids vary greatly in many respects, they all have essentially the same floral structure. The lower petal is modified into an unusual structure known as the lip and sometimes is prolonged into a spur. It is believed that the lip was originally the upper petal and that it became the lower by a twist of the ovary. It is almost always possible to recognize a plant as an orchid through the striking irregularity of its flower and through the fact that the calyx is placed on top of the ovary.

LADY'S-SLIPPER

PLATE 3

Cypripedium

DESCRIPTION: Herbs with large pouchlike flowers of various colors.

DISTRIBUTION: Somewhat widely distributed through the eastern United States and southern Canada.

There are several species of lady's-slipper, all of which are extremely showy and should be exempt from the ravages of the flower-picker. The lady's-slippers are easily distinguished from the other orchids by the fact that the lip has an inflated sack. This characteristic has given it the name "lady's-slipper" as well as another name, "moccasin flower," by which it is sometimes called.

Perhaps the most prized of the lady's-slippers is the showy lady's-slipper (*Cypripedium reginae*), which has large white flowers with crimson-magenta markings in front. This flower is the state flower of Minnesota, and may be found from Newfoundland to Minnesota and Georgia. The yellow lady's-slippers (*Cypripedium parviflorum* and *Cypripedium pubescens*) are easily distinguished by the yellow lip. They are more inclined than is the showy lady's-slipper to grow in rather dry upland woods. The stemless lady's-

slipper (*Cypripedium acaule*) has a flower quite like the showy lady's-slipper in color, but there is only one to a stalk and it grows in dry woods as well as in swampy woods. The small, white lady's-slipper (*Cypripedium candidum*) is found especially in open swamps and prairies.

The shape of the lady's-slipper is well designed to insure pollination. Once the bee has entered the lip for nectar, there is only one way out. It must brush past the stigma, which is covered with sticky hairs that comb the pollen grains from its back. Then it has to creep under an anther, getting another coating of pollen to carry to another flower.

SPRING PRAIRIE PLANTS

PRIMROSE FAMILY

Primulaceae

This family is widely distributed in the Northern Hemisphere and to a lesser extent farther south. It consists of herbs with simple leaves and five-parted, regular flowers, having the stamens opposite the petals and of the same number. The petals are grown together at the base into a tube so that the nectar can be reached only by bees and such other insects as have a long proboscis. Besides the shooting star, described below, this family includes the well-known cultivated primrose, many of which are native in Europe and in the western mountains. Other members of this family are the loosestrife, the pimpernel, and the cyclamen.

SHOOTING STAR

PAGE 505

Dodecatheon meadia

DESCRIPTION: Perennial herb with white, rose, or purple flowers with long, narrow petals bent backward.

DISTRIBUTION: On moist cliffs and in prairies, from Pennsylvania to Manitoba and south to Georgia and Texas. Especially characteristic of the central states. A closely related species grows in the western mountains.

The shooting star is appropriately named, for its showy and unusual-looking flower well suggests a star in motion. It is very closely related to the cultivated cyclamen, which it resembles in many respects. The flowers are clustered on a long stalk which arises from a rosette of pointed basal leaves. The separate flowers are nodding on slender stems. The five long, narrow petals bend back over the stem and expose the long yellow structures which contain the pollen. The bees, while sucking nectar, are dusted with pollen, which is jarred from the end of the cone. The flowers vary from white to pink or purple; they are often rose color.

The shooting star is sometimes called cowslip, although this name is more properly applied to some of the English primroses.

ROSE FAMILY

Rosaceae

This is an immense family consisting of thousands of species of trees, shrubs, and herbs. All of the members of the rose family have regular flowers and most of them have numerous distinct stamens inserted on the calyx. The family includes a large number of species that are of very great use to man. Of special importance are the numerous fruits, more of which come from this family than from any other, at least in the Temperate Zone. Included in the rose family, for example, are the apple, cherry, pear, plum, peach, apricot, quince, strawberry, raspberry, and blackberry. The almond also belongs to this family. In addition, a number of important ornamentals are included, such as the rose and the spiraea, and a great number of wild herbs and shrubs, such as the ninebark, meadowsweet, hardhack, goatsbeard, cinquefoil, and agrimony.

WILD STRAWBERRY

PAGE 505

Fragaria virginiana

DESCRIPTION: Perennial herb with running stem, white flowers, and red berries.

DISTRIBUTION: In meadows and open woods, from Newfoundland to South Dakota, Florida, and Oklahoma.



Photographs by Frank Morley Woodruff

Wild Strawberry

Shooting Star

The wild strawberry has dainty white five-petaled flowers, loosely clustered on a rather short stem, contrasting with green saw-toothed leaves. Its delicious red berries are known to all. Strawberries have long been cultivated and they have been greatly increased in size, but they have scarcely been improved in flavor.

Strawberries, both wild and cultivated, are propagated by runners which take root in the ground at certain distances from the parent plants. As soon as the new plants become well rooted the connecting stems die away and disappear, and the new plant begins independent life.

The common wild strawberry appears in various places such as meadows and open woods from Newfoundland to South Dakota, Florida, and Oklahoma. In addition to the common wild strawberry there may be mentioned also the wood strawberry (*Fragaria vesca*), whose achenes are superficial instead of in pits as in the common wild strawberry. The wood strawberry also grows in Europe, and it is from this that our ancestors first began to grow cultivated strawberries. Most of our cultivated strawberries at the present time have been derived from the Chilean strawberry (*Fragaria chilensis*).

SPRING SWAMP PLANTS

BUTTERCUP OR CROWFOOT FAMILY

(See Page 479)

MARSH MARIGOLD

PAGE 507

Caltha palustris

DESCRIPTION: Stem, hollow; leaves, round or kidney-shaped; flowers, bright yellow.

DISTRIBUTION: In swamps and wet meadows, from Newfoundland to Saskatchewan and south to South Carolina and Nebraska.

The marsh marigold is one of the freshest and brightest flowers to be seen in the spring. The leaves are a bright glossy green, and contrasting with them are the firm, waxy, saucer-shaped blossoms, several of which are borne on each stem. The flowers have no petals, but the yellow sepals, five to ten in number, are showy and serve as substitutes in attracting the insects for pollination. The flower is sometimes called cowslip, although the true cowslip is a European species of primrose. The stalks, leaves, and buds of the marsh marigold are used as a pot vegetable, and by some are considered superior to spinach. Marsh marigold is, however, much more bitter than spinach.

ARUM FAMILY

(See Page 494)

SKUNK CABBAGE

PAGE 507

Symplocarpus foetidus

DESCRIPTION: Perennial with large and broad veiny leaves; spathe, spotted and striped with purple and yellowish-green.

DISTRIBUTION: Swamps and moist springy grounds from Nova Scotia to Minnesota and south to North Carolina.

The unpleasant smell of this plant, like that of its namesake among the animals, announces its presence before it is seen. However, the odor serves a useful purpose in nature, since it attracts



Courtesy, Wild Flower Preservation Society
Upper right and lower left photographs by E. T. Wherry and E. L. Crandall

Blue Flag Iris
Skunk Cabbage

Marsh Marigold
Squarrose Sedge

flesh flies, just as the nectar-bearing flowers attract bees. Since the flesh flies are almost the only insects flying about in early spring when the skunk cabbage makes its appearance, it is dependent upon them for the distribution of its pollen. One might not suspect that the skunk cabbage is a close relative of the sweet flag and the calla lily, but such is the case. The flowers of the skunk cabbage resemble those of the calla lily, though they are as unattractive in appearance as the calla flowers are beautiful. The core of the skunk cabbage has a temperature as much as ten degrees higher than that of the atmosphere, which enables the plant to make its appearance early in the spring. This plant may well be called the true harbinger of spring, since it appears earlier than any of our northern flowers, frequently being found in March or sometimes as early as February in the northern part of the United States. When the bear awakes from his winter sleep, he may find the skunk cabbage his only food during the cold days. The Indians used to believe that this plant had great medicinal value. Like some other members of the family, it has a very acrid and unpleasant taste.

SEDGE FAMILY

Cyperaceae

The sedge family embraces more than 3,000 species of grasslike or rushlike herbs. Though they resemble grasses and are frequently spoken of as such, they have certain well-defined and distinctive characteristics. The leaves are three-ranked, while in the grasses the leaves are two-ranked upon the stem. The basal portion of each leaf incloses the stem as in the grasses, but in the sedges the sheaths are entirely closed, while in the grasses they are usually open at the side of the stem opposite the leaf. The sedges have slender stems which are almost always solid, whereas the stems of the grasses are hollow. The stems of the sedges are usually triangular, while the stems of the grasses are usually cylindrical. The flowers of the sedges are arranged in spikelets, and they are much less likely to be perfect than are the flowers of the grasses.

In addition to the sedges described here, this family in-

cludes the spike rushes, the bulrushes, the cotton grasses, and the beak rushes. The sedge family, although very large, contains comparatively few plants of importance. The best-known plant of the family in this respect is papyrus, used by the ancient Egyptians for making paper. One of the members of the family has edible tubers.

SEdge

PAGE 507

Carex

DESCRIPTION: Perennial grasslike herbs; flowers borne in spikes, dull green or brown.

DISTRIBUTION: Various species widely distributed in swampy places throughout North America.

The sedges form a large group, there being about one thousand species. The differences between the species are often so slight as to escape notice except upon close examination. The stems are triangular and the flowers are borne in spikes in which the staminate and the pistillate are variously arranged. In some of the sedges the entire spike is of one form of flowers, while in others the spikes are composed partly of one flower form and partly of another. In those in which the staminate and pistillate are separate, the staminate spike is slender while the pistillate spike increases in diameter when the seeds ripen. The flowers are dark green or brown and inconspicuous. Most sedges grow in swampy places, although some of them may be found in dry soil. They are much coarser and much less palatable to grazing animals than are the grasses. Some of the sedges are so sharp and rough that they cause cuts in the portion of the body coming sharply in contact with them.

IRIS FAMILY

Iridaceae

This family of perennial herbs includes the iris and blue-eyed grasses, also numerous cultivated plants such as the crocus and gladiolus. Saffron and orris also belong here. The family contains about a thousand species widely distributed throughout the world. There is a close relationship between this family and the lily and the amaryllis families.

The iris family differs from the lilies, however, in having the calyx tube adherent to the ovary; and from the amaryllis family in having only three stamens instead of six.

IRIS OR FLEUR-DE-LIS

PAGE 507

Iris

DESCRIPTION: Stems, 1 to 3 feet high; leaves, sword-shaped in two ranks; the leaves astride of each other in a common plane; flowers, blue in our native species.

DISTRIBUTION: In marshes and wet meadows, from Newfoundland to Manitoba and south to Florida and Arkansas.

The iris is named for the Greek goddess of the rainbow, showing that always, as now, it has been admired for its great beauty. It is one of the stateliest of flowers, and the cultivated species show a wide range of color. Ruskin called it the flower of chivalry because it had a sword for its leaf and a lily for its heart.

No flower has a more interesting structure than the iris. At first glance it would seem as though there were nine petals of different sizes; in reality, however, there are only three petals. The three petal-like outer divisions are sepals. The three petal-like inner divisions are branches of the style. Sheltered beneath these over-arching style-arms are the stamens. The large petals form a landing stage for the insect that comes in search of honey. If the insect comes in laden with pollen from a flower it has already visited, it must first come in contact with the stigma and leave its pollen there. Then, as it backs out, it brushes against the stamens and gets a fresh supply of pollen to be deposited on the next flower visited. Self-pollination is prevented because it is impossible for the pollen to reach the stigmas of the same flower.

Nearly eight centuries ago Louis VII of France adopted the iris as the emblem of his house. It was known as the "Flower of Louis," which later became *fleur-de-lis*. It is still the Lily of France.

The blue flag iris (*Iris versicolor*) is the best known species in North America. Its flowers are violet-blue, variegated with yellow, green, or white, and purple-veined. Its large rootstock yields a powerful drug known as "iridin," used in medicine. The German iris (*Iris germanica*), a large showy species having violet-purple sepals bearded with bright yellow, has been introduced from Europe and is much cultivated in gardens.



PLATE 3.

Columbine
Wintergreen
flower and fruit

© Painted from living plants expressly for THE CLASSROOM TEACHER
Wild Lily of the Valley
fruit and flower

Showy Lady's-slipper
Cup Plant



PLATE 4.
Wild Morning-glory
Oxeye Daisy

© Painted from living plants expressly for THE CLASSROOM TEACHER
Red Clover
Turk's-cap Lily

Evening Primrose
Field Thistle

HERBS OF THE SUMMER WOODS

COMPOSITE FAMILY

(See Page 513)

CUP PLANT

PLATE 3

Silphium perfoliatum

DESCRIPTION: A large, coarse plant with a square stem, 4 to 8 feet high; leaves, opposite and large, the upper ones uniting at their base to form cups; hence the common name.

DISTRIBUTION: Southern Ontario to Minnesota, Georgia, and Louisiana.

This plant is striking because of its cuplike leaves, which give it its common name. These cups retain water for some little time. It is not known whether these plants supplement their usual supply of water in this way or not.

HEATH FAMILY

(See Page 483)

INDIAN PIPE

PAGE 513

Monotropa uniflora

DESCRIPTION: Low herb entirely without green coloring; nodding white or pinkish flower.

DISTRIBUTION: In dark, moist, rich woods nearly throughout temperate and warm North America.

It is not easy to find the Indian pipe in the woods, for it is often hidden under the leaves; once found, however, it is easily recognized by its peculiar waxy whiteness. The flower is nodding and with its stalk it has a shape suggesting the common name. On account of its whiteness and fleshlike aspect it is sometimes called the corpse or ghost flower. It is entirely without green coloring and gets all of its food from dead organic matter in the ground. When it is dried, it turns black.

The Indians used this plant considerably, making a tea from it before going hunting, believing it would bring them good luck. They also used it for medicine. The Indian pipe grows in deep,

rich woods, and its flowers may be looked for in July or August. It is especially likely to be found underneath the beech and maple trees.

WINTERGREEN

PLATE 3

Gaultheria procumbens

DESCRIPTION: Creeping evergreen herb with small white flowers and red berries.

DISTRIBUTION: In woods, especially under evergreen trees from Newfoundland to Manitoba and south to Georgia.

The wintergreen is a plant with a small, woody, creeping stem. From this stem there rise flowering branches and dark, shiny evergreen leaves. Beneath the leaves in summer are small white bell-shaped flowers which are followed by bright red berries. The leaves, flowers, and berries all have the same spicy, aromatic flavor, so familiar to all in candy, chewing gum, etc. Wintergreen is also used for certain medicinal purposes.

GOURD FAMILY

Cucurbitaceae

This family, which consists mostly of natives of tropical regions, includes such familiar cultivated plants as the pumpkin, squash, gourd, melon, and cucumber. All the members of this family have trailing herbaceous vines, usually with tendrils.

WILD CUCUMBER

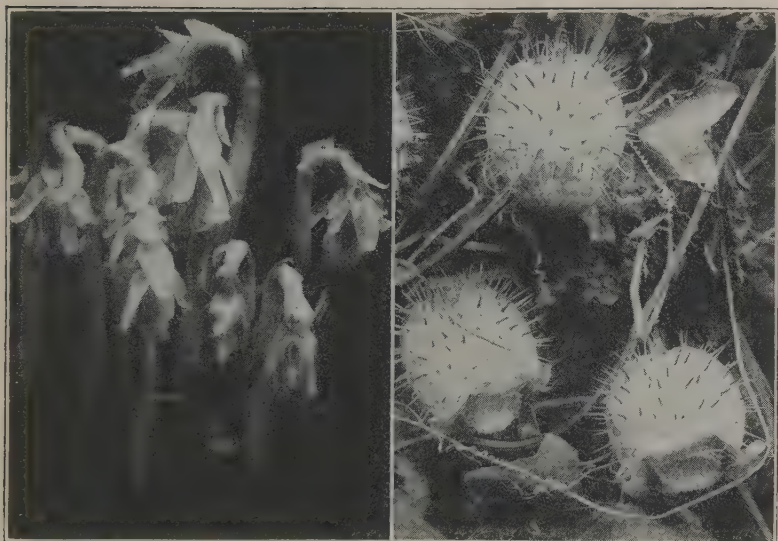
PAGE 513

Echinocystis lobata

DESCRIPTION: Annual climbing herb with clusters of greenish-white flowers.

DISTRIBUTION: Especially along rivers from New Brunswick to Manitoba and south to Texas. It often grows as an introduced plant and sometimes is cultivated.

This is a tall, climbing vine with three-forked tendrils. It sometimes reaches a height of twenty-five feet in a single season. The leaves are thin and have five deep, sharp lobes. The small greenish



Left photograph, courtesy, Chicago, Milwaukee & St. Paul Railway

Indian Pipe

Wild Cucumber

flowers are monoecious, that is, the pistils and stamens are in separate blossoms on the same plant. The fruit is green and egg-shaped, about two inches in length, and very much suggests a small cucumber. It is covered with slender spines. The seeds are large, flat, and dark. The wild cucumber is very frequently called the wild balsam apple.

SUMMER FIELD AND MEADOW FLOWERS

COMPOSITE FAMILY

Compositae

This is the largest family of flowering plants, and consists of over ten thousand species. The reason for its name is seen in the way the flowers are made up. In a daisy, for example, what appears as an ordinary flower is not a flower at all, but an aggregation of a large number of individual flowers grouped together closely into what is called a *head*. What appear as petals in a daisy are really individual flowers known

as *ray flowers*. The yellow central part is known as the *disk*. The lower part of the head is covered by a large number of green leaves known as *bracts*. All of them taken together form what is known as the *involucre*. There is, therefore, a very strong resemblance in a head like that of a daisy to an individual flower in other plants. The involucre resembles the calyx, the ray flowers resemble the corolla with its petals, and the disk flowers resemble the stamens and pistils.

This large family includes a great number of familiar flowers, such as the daisy, the sunflower, the black-eyed Susan, the thistle, and the compass plant, all of which are described below, the asters (p. 548), the goldenrod (p. 548), the ragweed (p. 534), the burdock (p. 533), the dandelion (p. 533), the ironweed, boneset, arnica, tansy, and many more. In this family also there are a great number of important cultivated plants, such as lettuce, chicory, endive, artichoke, wormwood, and a large variety of ornamental plants, such as the cultivated aster, the chrysanthemum, and the dahlia.

OXEYE DAISY

PLATE 4

Chrysanthemum leucanthemum

DESCRIPTION: Herb with yellow disk and white rays.

DISTRIBUTION: Widely distributed throughout eastern United States. Introduced from Europe.

The word "daisy" was originally "day's eye." The white or oxeye daisy has a bright yellow center made up of many individual flowers. The white ray flowers are sterile; that is, they never produce seeds, as do some members of the composite family. The function of the sterile flowers seems to be to attract insects for fertilizing the fertile flowers in the disk. The daisy is a very hardy plant which thrives well in sterile soil as well as in good soil. This showy plant is deservedly a favorite, and is now widely distributed throughout the eastern United States. It is, however, not native to North America at all, but has been introduced from Europe. In many parts of the United States this plant is so common in fields and meadows that many farmers regard it as a pest rather than a thing of beauty. It spreads very rapidly and crowds out other plants and

especially grasses, which, from the farmer's point of view, are of course much more desirable. The oxeye daisy is characteristic of meadows, pastures, waste places, and roadsides. It has been made the state flower of North Carolina.

In the same genus as the oxeye daisy come all the cultivated chrysanthemums.

BLACK-EYED SUSAN

PAGE 519

Rudbeckia hirta

DESCRIPTION: Biennial herb with lance-shaped leaves and flowers made up of a dark purple or brown disk surrounded by yellow to orange rays.

DISTRIBUTION: Originally native in the prairies and plains from Ontario to Manitoba and south to Texas; now also distributed very widely throughout the eastern United States.

This beautiful plant is one of the favorite flowers of the composite family, and it is interesting to know that it is spreading rapidly through various parts of the country in which it was not originally native. It is the state flower of Maryland. The plant is very rough and hairy throughout, and the stems are simple, or nearly so. The large heads are made up of dark purple or brown flowers surrounded by from ten to twenty golden to orange rays. This plant grows readily in open places and thrives particularly well in prairies, meadows, and swamps. Very closely related to the black-eyed Susan is the wild golden glow (*Rudbeckia laciniata*), which is commonly found in moist lowland woods, especially along streams. A form of the golden glow is very common in cultivation.

SUNFLOWER

PAGE 519

Helianthus annuus

DESCRIPTION: Large, coarse plant with flower made up of dark purple or brown disk and bright yellow rays.

DISTRIBUTION: Native in central United States from Minnesota to Texas and westward.

The sunflower is the largest of the familiar members of the composite family. It is a coarse, stout herb reaching a height of from three to six feet, or even more. The many flowers form a dark purple or brown disk, from which radiate the showy bright golden

rays. Under cultivation the sunflower grows much larger, sometimes fifteen feet high, with correspondingly larger flowers. It has spread considerably in waste lands and has also long been cultivated as an ornamental plant and for its seeds.

There are many varieties of sunflower native to the prairies and woodlands of the central United States. Among them is the Jerusalem artichoke (*Helianthus tuberosus*), which has been planted to some extent for its starchy tubers. The sunflower has been introduced into other continents where it has been rather extensively cultivated. In Russia its seeds are eaten much as peanuts are in this country. Sunflower oil is extensively used in making candles, soaps, etc. The sunflower is the state flower of Kansas, which is called the Sunflower State.

THISTLE

PLATE 4

Cirsium

DESCRIPTION: Herbs with prickly leaves and bulging heads of flowers ranging from white to purple.

DISTRIBUTION: Widely distributed in cultivated fields and pastures, and along roadsides.

The thistle is one of the most common plants of fields and waysides, and many of the species are among our worst weeds. The lance-shaped leaves are armed with sharp spines, which prevent the eating of the plants by grazing animals. As a consequence, thistles maintain themselves readily in pastures and increase in numbers because animals permit them to go to seed. It not infrequently happens that grasses which are closely cut are crowded out by the thistles. On this account, and for other reasons, the farmer considers the thistle a very serious pest in pastures and in grain fields.

By far the most serious of all the thistle pests is the so-called Canada thistle (*Cirsium arvense*). This plant is a native of Europe, but was called the Canada thistle in the United States because it was introduced into that country through Canada. It owes its serious nature as a weed to its extensive and deep rootstock, which spreads very rapidly through fields at a deep level and makes the plant difficult to eradicate. Even when attempts are made to dig up the Canada thistle, the rootstock merely breaks up and makes that many more plants to propagate its kind. The head of the Canada thistle is comparatively small and the flower light-colored.

Another common thistle is the burr or spear thistle (*Cirsium lanceolatum*), also introduced from Europe, and a weed in pastures and elsewhere, though not so serious a pest as the Canada thistle because it does not spread by rootstocks. All thistles, however, spread rapidly by seeds similar to those of the dandelion. The burr thistle has a very long and handsome head of purple flowers.

Besides these two thistles named above, there are many native species of thistles most of which are very beautiful both in flower and in fruit; among these is the field thistle (*Cirsium discolor*). On account of their prickly nature, however, and because they abound in fields where they are not wanted, the thistles are not among the most popular of plants.

COMPASS PLANT

PAGE 519

Silphium laciniatum

DESCRIPTION: Coarse, rough, bristly plant with pinnate leaves; 3 to 10 feet high with conspicuous heads of flowers, somewhat resembling sunflowers.

DISTRIBUTION: Prairies from Ohio to South Dakota and south to Alabama and Texas.

This plant is also called rosinweed, as are some other species of the same genus. It is named compass plant owing to the fact that the leaves are vertical and face either east or west, not north or south. This habit is believed to have some significance in protecting the plant from excessive evaporation in the heat of the day, while exposing the broad surface of the leaves to the early morning and late afternoon sun.

EVENING PRIMROSE FAMILY

Onagraceae

This is a widely distributed family of about four hundred species and consists of annual or perennial herbs. In addition to the evening primrose and the fireweed, which are described here, this family includes the marsh purslane, the enchanter's nightshade, the sundrops, and the gauras. In the evening primrose family the flowers are four-parted, perfect, and symmetrical; the calyx tube adheres to the ovary.

EVENING PRIMROSE

PLATE 4

Oenothera

DESCRIPTION: Stout, erect plants with alternate leaves and white, yellow, or rose-colored flowers.

DISTRIBUTION: In dry fields and along roadsides from Labrador to Florida and west to the Great Plains and Rocky Mountains.

The evening primrose is so called because its blossoms do not open until nightfall. The color of the flower varies in different species but most of them are white or yellow and hence are more conspicuous at night than they would be if they were of darker colors. The common evening primrose has a pale yellow flower. Most of the evening primroses have a seductive fragrance which entices moths to them in great numbers. In these flowers the nectar lies deep and can be reached only by long-tongued moths. The flowers are very numerous and large, and open on successive nights for a period of many weeks. Often, however, only one or two flowers will open at one time. This makes it likely that the pollen can be carried to a flower on another plant and thus insure cross-fertilization. In the morning the blossom hangs limp and withered unless, perchance, no moth has come to sip its nectar; then it may remain open for an hour or so until it is visited by a humming bird or bee.

The evening primrose should not be confused with the true primrose, which belongs to a very different family. In addition to the common evening primrose (*Oenothera biennis*), there are many other species of this genus, most of which are attractive and beautiful. Especially beautiful are the large-flowered species which occur in the western states. Some of the smaller evening primroses (*Oenothera fruticosa*) are known as sundrops.

FIREWEED OR GREAT WILLOW HERB

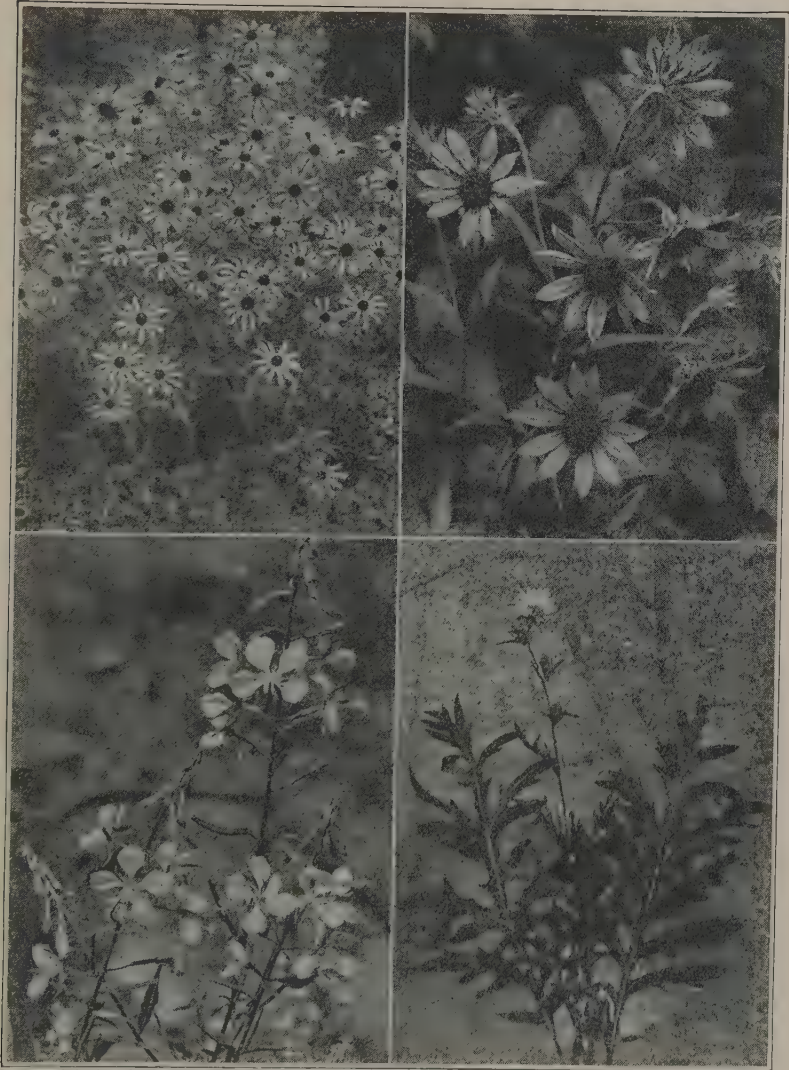
PAGE 519

Epilobium angustifolium

DESCRIPTION: A tall, coarse plant, 3 to 8 feet high; leaves, numerous and lanceolate; flowers, pink or magenta in color and very showy.

DISTRIBUTION: Greenland to Alaska, North Carolina, Arizona, and California.

This handsome member of the evening primrose family is especially abundant on lands which have been swept by forest fires,



Lower right-hand photograph by Frank Morley Woodruff

Black-eyed Susan

Giant Sunflower

Fireweed

Compass Plant

many otherwise desolate places being made bright by its tall spikes of purplish-pink or magenta flowers. The name willow has reference to its willow-like leaves. The flowers are constructed so as to prevent self-fertilization. The styles are curved downward until the pollen from a particular flower is gone. Then the styles turn upward so that no insect that has come from another flower can obtain nectar without leaving pollen grains upon the exposed stigma. The pods are long, slender, and violet-tinted, and contain numerous seeds which have long, cottony hairs, fitting them for easy dispersal by the winds. When the seeds are ripe, the pods burst and the seeds are widely scattered by the breezes.

On account of the great number of seeds produced by this plant and the easy scattering of these seeds, the plant readily takes possession of burned-over areas. It is for this reason that it has generally been called fireweed.

PULSE FAMILY

(See Page 498)

CLOVER

PLATE 4

Trifolium

DESCRIPTION: Low herbs with leaves made up of 3 leaflets; small flowers in dense heads.

DISTRIBUTION: Widely distributed throughout the United States and Canada.

This group of plants gets its Latin name as well as its common name, trefoil, from the fact that each leaf is made up of three leaflets. There are many species of clover, some having white, pink, red, or purple flowers, and some with yellow flowers. In all clovers the florets are small and massed together in heads. When these florets are examined individually they are found to have the typical shape of most members of the pulse family. Clover provides a wealth of honey for bees and butterflies. The visit of these insects is necessary in order that the clover may produce its seeds. Like other members of the legume or pulse family the clover enriches the soil by reason of the bacteria which flourish in the roots.

The red clover (*Trifolium pratense*) is the state flower of Vermont. It has comparatively large heads of flowers ranging from pink to purple. The white clover (*Trifolium repens*) is smaller and

has smaller heads with white flowers which become reflexed in age. Both of these species were originally introduced from Europe, but are now common in both the United States and Canada.

LILY FAMILY

(See Page 488)

TURK'S-CAP LILY

PLATE 4

Lilium superbum

DESCRIPTION: Perennial with stem 3 to 8 feet high; flowers, 3 or more in terminal cluster, orange with many dark purple spots on the inside.

DISTRIBUTION: Rich low ground from New Brunswick to Virginia and west to Minnesota and Missouri.

The Turk's-cap lily, as its Latin name implies, is a superb flower. It is the tallest and most profusely blossoming and most brilliantly colored of all the wild lilies. The perianth, with its six divisions, curves gracefully backward, giving prominence to the long stamens and style. These gorgeous flowers appear in clusters, with sometimes as many as forty at the end of a single plant. This lily may be successfully cultivated in gardens.

Two other wild lilies of somewhat similar range are the wild lily (*Lilium canadense*) which is found in meadows and open woods, and the beautiful wild orange-red lily (*Lilium philadelphicum*), found in open sandy woods.

MILKWEED FAMILY

Asclepiadaceae

Members of this family have milky juice, as the name indicates. The leaves are opposite and the seeds are in pods. The pollen of the flowers sticks together in waxlike masses, known as pollinia. The family consists of about two thousand species widely distributed throughout the world, chiefly in the tropics and warm temperate regions. In addition to the common milkweed, described here, we have many other species of milkweeds, some of which are very beautiful, such as the swamp milkweed and the butterfly weed.



Virgin's Bower



Common Milkweed

MILKWEED

Asclepias syriaca

DESCRIPTION: Perennial herb with greenish-white or dull pink or purple flowers in umbels.

DISTRIBUTION: In waste places from New Brunswick to Saskatchewan, North Carolina, and Kansas.

The common milkweed is a plant that we are too commonly inclined to despise. Its flowers are not particularly beautiful and its sticky, milky juice is not pleasant to the touch or smell. The plant also is coarse in aspect and may be a rather bad weed in places. However, it is wonderfully adapted for perpetuation. The blossoms are rich in nectar, and in order to obtain this, bees and other insects must penetrate deep into the flower and pull out the masses of pollen, which stick to the legs of the insect. Not infrequently insects have their legs caught in the flower so that they cannot get away. The seeds are enclosed in a pod and have attached to them wings of silky hair which insure their distribution. The flowers are in umbels and range in color from greenish-white to dull purple.

The white juice of the milkweed plant is its most striking characteristic. When we let a drop of it dry on the back of the hand, we find that it is elastic. It is not the sap of the plant, but is a special secretion.

The butterfly weed (*Asclepias tuberosa*) is a plant of spectacular beauty on account of its handsome orange-colored flowers. It is rather common in sandy places throughout the United States. The swamp milkweed (*Asclepias incarnata*), with its showy rose-purple flowers, is very common in swamps.

BUTTERCUP OR CROWFOOT FAMILY

(See Page 479)

CLEMATIS OR VIRGIN'S BOWER

PAGE 522

Clematis virginiana

DESCRIPTION: Tall, herbaceous vine having compound leaves with 3 leaflets; small white flowers in large panicles.

DISTRIBUTION: Nova Scotia to Manitoba, south to Georgia and Tennessee.

This beautiful vine is especially abundant along river banks, where it climbs over shrubs and trees and adds a fine touch of floral beauty to the summertime. The plant climbs by the bending or clasping of the leaf stalks. The fruit has conspicuous feathery tails. A number of other species of clematis, many of which have large blue flowers, are cultivated as ornamentals in gardens.

MORNING-GLORY FAMILY

Convolvulaceae

The morning-glory family is a small family consisting chiefly of herbaceous vines. It gets its scientific name from the fact that the corolla is convolute or twisted in the bud. The corolla, in which the five petals are more or less united, has a characteristic funnel- or bell-shaped form. In addition to the wild morning-glory, or bindweed, described here, this family includes all of the cultivated morning-glories and also the sweet potato.

WILD MORNING-GLORY OR BINDWEED

PLATE 4

Convolvulus sepium

DESCRIPTION: Twining plant with flaring, funnel-shaped white or pink flowers.

DISTRIBUTION: In fields and thickets, usually in moist soil, from Newfoundland to North Carolina and New Mexico.

The wild morning-glory is a very beautiful vine and has large, showy flowers. By farmers it is regarded as an almost intolerable nuisance on account of its rapid spread, and of the difficulty in exterminating it because of its widely spreading roots and underground stems. The leaves are smooth, long, and triangular. The flaring, funnel-shaped flowers are white or pink. They open in the morning and close at sundown.

SUMMER SWAMP AND POND PLANTS

SUNDEW FAMILY

Droseraceae

This is a family of insect-eating plants. The leaves secrete a sticky substance which attracts insects and holds them captive.

SUNDEW

PAGE 527

Drosera

DESCRIPTION: Leaves in a rosette at the base, often wine-red in color; flowers, white, on tall, slender scapes.

DISTRIBUTION: Bogs or wet sand from Newfoundland to Alaska, south to Florida and Alabama, and west in the mountains to California.

The leaves of the round-leaved sundew or dew plant are covered with glandular hairs, tipped with sticky drops which glitter in the sunlight. Insects alight upon these leaves, being attracted by the rich winelike color and the glittering drops which look attractive to them. The gluelike secretion holds the insect fast and the harder it struggles, the firmer it is held. The leaves curl over the insect and hold it the more securely. Juices are then secreted by the leaves

which, like the gastric juices of our stomachs, serve to digest the insect and nourish the plant. The flowers are small and white and are borne in considerable numbers on scapes. They open only in the sunshine.

ROSE FAMILY

(See Page 504)

MEADOWSWEET

PAGE 527

Spiraea latifolia

DESCRIPTION: Erect shrub, 2 to 6 feet high; flowers, white or pinkish in dense terminal panicles.

DISTRIBUTION: In moist soils from Newfoundland to Saskatchewan and south to Virginia.

The meadowsweet belongs to the spiraea branch of the rose family. It is an erect shrub with reddish or purplish stems and simple toothed leaves. The flowers are in thick clusters and are white or pink and very fragrant. The stamens with their threadlike filaments give a feathery effect to the blossoms.

The meadowsweet is closely related to the hardhack (*Spiraea tomentosa*) which is rather characteristic of wet, sour land. The meadowsweet is also known as queen of the meadow. It is a very graceful plant.

BORAGE FAMILY

Boraginaceae

The borage family has some fifteen hundred species. Most of these plants are rough, hairy herbs with entire leaves and symmetrical flowers with regular five-lobed corolla. The fruit consists of four seedlike nutlets. A great many plants of this family have beautiful flowers, blue perhaps being the most prevalent color. To this family belong the heliotrope, which is cultivated because of its fragrant flowers, the puccoons, and the lungwort or Virginia bluebell, as well as the forget-me-not. This family also has its share of weeds, such as the hound's-tongue and beggar's-lice, whose seeds stick tenaciously to animals and human clothing.

FORGET-ME-NOT

PAGE 527

Myosotis scorpioides

DESCRIPTION: Low perennial herb with loose racemes of small blue flowers with a yellow eye.

DISTRIBUTION: Native of Europe and Asia, now widely distributed in brooks and marshes from Newfoundland to Tennessee, having escaped from cultivation.

Since far back in human existence, legend and sentiment have attached themselves to the forget-me-not, which is one of the most popular flowers. The golden cue or eye at the center of the flower acts as a guide to the bee which, inserting its tongue at this point, gets the nectar and at the same time touches both anther and stigma, thus fertilizing the flower.

A similar native species of forget-me-not (*Myosotis laxa*) is common in woods and wet ground from Newfoundland and southward.

PITCHER-PLANT FAMILY

Sarraceniaceae

The members of this family have leaves shaped like trumpets or pitchers which serve as traps for insects. Like other insectivorous plants, the pitcher plant grows especially in bogs.

COMMON PITCHER PLANT

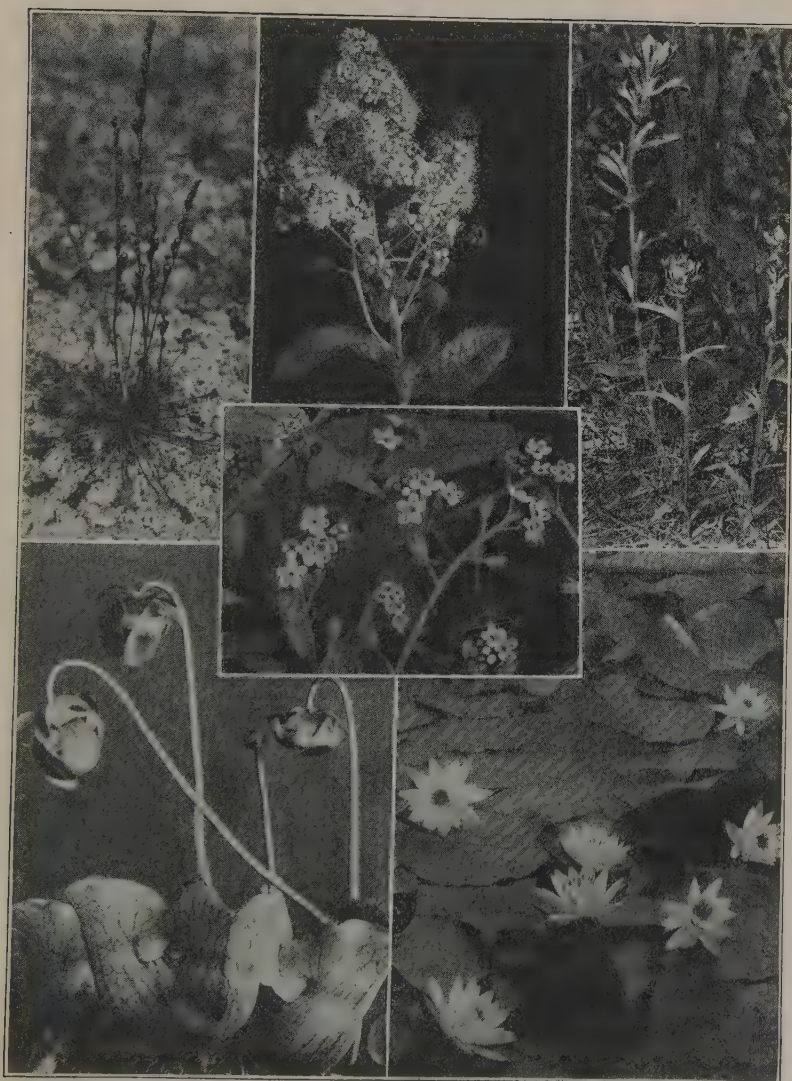
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Sarracenia purpurea

DESCRIPTION: Leaves, pitcher-shaped; flowers, globe-shaped, deep reddish-purple, sometimes greenish or yellow.

DISTRIBUTION: In peat bogs from Labrador to the Canadian Rocky Mountains and south to Florida and Kentucky.

Like the sundew, the pitcher plant catches numbers of insects, though in quite a different way. The leaves are hairy and shaped like a pitcher. They are reddish or green on the outside and paler green, streaked with crimson, on the inside. They have a flaring hood at the top and are generally partly filled with water. Insects, which may be lured to the plant by its attractive colors, slip into the water and are drowned. At the mouth of the pitcher are numer-



Courtesy, Wild Flower Preservation Society
Upper left and lower right photographs by C. R. Shoemaker and E. L. Crandall

Sundew

Meadowsweet

Painted Cup

Pitcher Plant

Forget-me-not

Water Lily

ous hairs pointing downward which feel soft and velvety to the insect crawling down, but are bristly and sharp if the insect tries to reverse its direction. Escape is therefore quite impossible for a crawling insect, once it begins the downward course. In time the insects become decomposed and it has been thought that the pitcher plant utilizes some of the material as food. This has not been definitely proved, however, except in the case of certain tropical forms of pitcher plant. As might be expected, the disintegrating insects cause the plant to have a rather unpleasant odor. The nodding flowers are arranged singly on naked scapes. Several other species of pitcher plant are found in swamps in the southern states.

FIGWORT FAMILY

Scrophulariaceae

This large family is made up chiefly of herbs with bitter juices. Some of them are narcotic and poisonous. The family includes the mullein (p. 541), butter and eggs or toadflax (p. 540), the snapdragon, the monkey flower, the foxglove, and the painted cup, which is described below. The family is characterized by a fruit which consists of a two-celled capsule; the flowers usually are two-lipped and more or less irregular; the leaves may be alternate or opposite.

PAINTED CUP OR INDIAN PAINT BRUSH

PAGE 527

Castilleja coccinea

DESCRIPTION: Annual or biennial herb, 1 to 2 feet high, with inconspicuous yellow flowers, the brilliant color of the plant being due to the upper leaves which subtend the flowers.

DISTRIBUTION: Low sandy ground from Massachusetts to Manitoba and south to Virginia and Texas.

The painted cup is well named, for the species often give a very brilliant color to the landscape where they are found in numbers. The beauty of the plant is due, not to the flower, but to the highly colored leaves which surround it and look, at first glance, like petals. They vary in color from lemon-yellow to intense scarlet. Fields of scarlet painted cups are particularly showy.

These plants get their food in an interesting way. Although the

leaves are green, which shows that they manufacture sugar as do ordinary plants, the plants are none the less root parasites. That is, their roots attach themselves to the roots of other plants from which they get a portion of their food. This is particularly the reason why it is so difficult, and even perhaps impossible, to transplant painted cups successfully. In the western mountains there are numbers of species of painted cups which beautify the mountain-sides with colors as varied as those of the rainbow.

WATER-LILY FAMILY

Nymphaeaceae

The members of the water-lily family live in fresh water and are widely distributed. They have horizontal rootstocks and leaves and in many species there are leaves which float on the surface of the water. Generally the plants are large and in many species the blossoms also are of great size. The leaves and flower of the *Victoria regia* are actually enormous, the leaves sometimes being several feet in diameter.

The water lily affords an excellent illustration of the evolution of the flower. In the ordinary white water lily one may readily see all the steps between petals and stamens, the change being so gradual that in many instances one is unable to tell whether the organ observed is a petal or a stamen. Some may be regarded as practically both.

WATER LILY

PAGE 527

Castalia

DESCRIPTION: Aquatic herbs with floating leaves and showy flowers.

DISTRIBUTION: The common water lily, the white water lily (*Castalia odorata*), is found in various small streams from Newfoundland to Manitoba and south to Florida and Louisiana. *Castalia tuberosa* is found from Lake Champlain west to the Great Lakes and south to Delaware and Arkansas.

The water lily is a beautiful and queenly flower. Its Latin name is that of the mythical fountain on Mount Parnassus which was

sacred to Apollo and the Muses. The various species of water lily are alike in having from four to six green sepals and numerous petals in many rows, many gradually passing into stamens. Originally there were a great many more stamens than there are at present, but many of these were gradually transformed into petals. These make the flower more beautiful and more attractive to insects. The leaves are dark green above and purple on the underside. The solitary blossom, which opens shortly after sunrise and closes in the afternoon, may be as much as five inches in diameter. It is pure white tinged with pink and is very fragrant. The stamens and pistils mature at different times, thus insuring cross-fertilization.

SEDGE FAMILY

(See Page 508)

BULRUSH

PAGE 531

Scirpus

DESCRIPTION: A coarse, perennial, leafless plant.

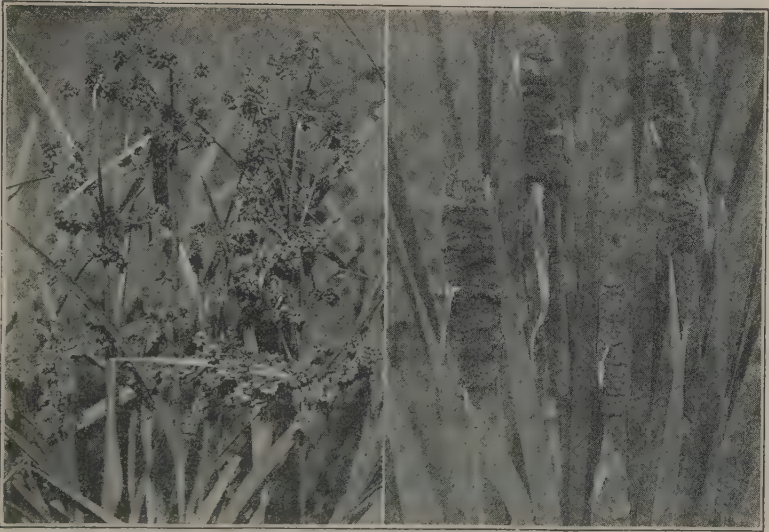
DISTRIBUTION: In marshes throughout most of North America.

The great bulrush (*Scirpus validus*) sometimes reaches a height of nine feet and is a very widely distributed plant on the margins of ponds. Toward the top of the leafless stem are borne inconspicuous umbels of brownish flowers. Various other species of rushes are also widely distributed in swamps, one of the best known being chair-makers' rush or sword-grass (*Scirpus americanus*), which differs from the great bulrush in having triangular rather than cylindrical stems. This species is sometimes used for making chair bottoms. Salt marsh bulrush (*Scirpus robustus*), found in salt marshes near the Atlantic coast, has stout, sharply angled stems bearing dense clusters of large oblong brownish spikelets.

CAT-TAIL FAMILY

Typhaceae

The cat-tail family consists of about ten species of marsh or aquatic plants with creeping, woody roots and smooth, erect stems.



Bulrush

Cat-tail

CAT-TAIL*Typha latifolia*

DESCRIPTION: Flowers in a dense cylindrical spike, brown or black, at the end of the stem.

DISTRIBUTION: In marshes throughout North America and all the other continents. This is one of the most widely distributed of all plants.

In this plant the long cylindrical spike of flowers, which resembles a cat's tail in appearance, is made up of staminate or male flowers above and pistillate or female flowers below. After the pollen has been shed the staminate flowers die away but the pistillate portion remains and becomes the well-known cat-tail of the summer and autumn swamps. The pollen, which is carried by the winds, forms a yellowish coating on the pistillate flowers in spring. The cat-tail has a heavy rootstock, rich in starch, and may be regarded as a potential food. The Indians dried and pulverized it and obtained a flour which they used for bread and puddings.

In addition to the broad-leaved cat-tail which has been described, a narrow-leaved cat-tail (*Typha angustifolia*) is frequently seen.

WEEDS

AMARANTH FAMILY

Amaranthaceae

The word "amaranth" means unfading, and the name is applied to a family of weedy herbs because most of its members have flowers which do not wither, but retain their form and color when dry. This family includes the prince's-feather and some of the tumbleweeds as well as the pigweed, or green amaranth, which is described below. The cultivated cockscomb of our gardens also belongs in this family as well as some of the plants that are cultivated as everlastings.

PIGWEEED OR GREEN AMARANTH

PAGE 535

Amaranthus retroflexus

DESCRIPTION: Annual plant from 1 to 10 feet in height, commonly about 3 to 5 feet; flowers, small and green and in thick clusters.

DISTRIBUTION: Throughout North America, north to Nova Scotia, North Dakota, and Washington. Naturalized from tropical America.

The green amaranth, or pigweed, is a rough, hairy plant with red roots, which accounts for the name redroot, so frequently applied to it. The stem is stout and usually branched, and there are dull green alternate leaves and small green flowers in spiked clusters. This plant is a very bad weed in gardens and on farms. It is frequently distributed with clover seed; hence it is desirable that clean clover seed should be insisted upon by those purchasing it. The pigweed produces enormous numbers of black, shiny seeds. Since it is an annual and spreads only by seed, it is easily exterminated by cutting or pulling before the seeds are mature.

Several other species of amaranth are more or less important as weeds, especially the tumbleweed (*Amaranthus graecizans*). The tumbleweed is so called because it tumbles over the fields and prairies, scattering its seeds widely in the autumn. No plant seems better fitted with means of dispersal than the tumbleweed. Obviously this also should be cut or pulled before the plant matures.

COMPOSITE FAMILY

(See Page 513)

DANDELION

PAGE 535

Taraxacum officinale

DESCRIPTION: Perennial herb, arising from a tap root; leaves in a ground rosette, lance-shaped and deeply lobed; flowers, yellow.

DISTRIBUTION: Widely distributed throughout North America. Naturalized from Europe.

The name "dandelion" comes from the French, *dent de lion*, meaning lion's tooth. The Latin name, *Taraxacum dens-leonis*, sometimes given to the dandelion, means the same. The name, of course, applies to the deeply-toothed leaves. The dandelion has been much cultivated and used for greens. It is also used in medicine and the root has sometimes been used as a substitute for coffee in much the same way as chicory. The milky juice of the plant has medicinal properties. On the whole, however, the dandelion is regarded much more as a pest than as a useful plant, because it spreads so fast on lawns, where it is apt to crowd out the more desirable blue grass. It blossoms early in the spring and continues to bloom all spring, producing great crops of feathery, wind-blown seeds. Each head may have from 150 to 200 flowers and each flower has the capacity for developing a seed. The dandelion flower closes at night and on rainy days, and opens in the sunshine.

The most important point to be considered in exterminating the dandelion is the prevention of seeding. It is also necessary to keep the grass closely cropped. Spraying with iron sulphate solution has been found successful in some cases.

BURDOCK

PAGE 535

Arctium lappa and *Arctium minus*

DESCRIPTION: Biennial, from 1 to 3 feet in height, with large, roundish or heart-shaped, ill-smelling leaves; the flowers, usually purple but sometimes white.

DISTRIBUTION: Common in waste places from New Brunswick to Alabama and the Rocky Mountains, the Great Basin, and on to the Pacific coast. Naturalized from Europe.

The burdock is a large, coarse, branching biennial herb, common in waste places. It has rather large heads of purple, or sometimes white, flowers. The bracts have stiff points with hooked tips. When these heads are dry and the seeds mature they attach themselves to men and animals and are readily and widely distributed. Although the burdock is a very unpopular plant, it has its uses. The leaves may be eaten as a vegetable and the stems peeled and used much as rhubarb is. The root is used in medicine.

Since the burdock is a biennial, it may be destroyed by cutting off below the ground during the spring or summer. During the first year, growth may be readily destroyed by pulling the plant out by the root when the ground is wet.

RAGWEED

PAGE 535

Ambrosia artemisiaefolia

DESCRIPTION: Coarse, annual weed, usually about 1 to 2 feet high; flowers, greenish and inconspicuous; leaves, alternate and almost dissected.

DISTRIBUTION: Nova Scotia to British Columbia and south to Florida and Mexico.

Whoever named the ragweed "ambrosia" must have been a humorist, since the ambrosia of the ancients was the food of the gods. The ragweed is a very pestiferous plant and is without any desirable attributes. It is one of the meanest annual weeds of gardens and cultivated fields and develops seeds in great quantities, which are spread with great ease. The pollen of the ragweed is very abundant and spreads widely in the wind. It is very irritating to the nostrils and is recognized as one of the most frequent causes of hay fever.

From every point of view, the extermination of the ragweed is highly desirable. The ragweed has two kinds of flowers, the male flowers being conspicuous and disposed in long spikes, whereas the female flowers are single and concealed. Since the ragweed is an annual, it may be exterminated by pulling or cutting before the seeds mature.

Closely related to the ragweed is the giant ragweed (*Ambrosia trifida*), which grows abundantly in rich soil along rivers and reaches a height of from three to fifteen feet. It is often a particularly bad weed especially in cornfields and bottom lands.



Center photograph by L. V. Hallock

Courtesy, Wild Flower Preservation Society

Common Ragweed

Common Burdock

Dandelion

Dandelion
fruit

Pigweed

MUSTARD FAMILY

Cruciferae

This is a large family of herbs, all of which have sharp and biting watery juice. It includes not only the mustards but the peppergrasses and the shepherd's-purse, which also are very bad weeds, and also the sweet alyssum, which is cultivated in gardens. Some of the woodland herbs, such as toothwort and spring cress, belong to this family. It also includes a number of important vegetables, such as the cabbage, turnip, cauliflower, kohl-rabi, radish, horseradish, and water cress. The scientific name of the family means "cross-bearing" and it was given because the four petals of the regular flowers form a cross. The seeds are contained in pods.

MUSTARD

PAGE 539

Brassica

DESCRIPTION: Annual or biennial herbs, 1 to 7 feet high, with yellow flowers.

DISTRIBUTION: Widely distributed throughout most of North America. Naturalized from Europe.

The common wild mustard is one of our very worst weeds, especially in grain fields, which are sometimes yellow with its blossoms. There are many species of mustard, some of which furnish the mustard of commerce. The worst of our common mustards probably is the charlock (*Brassica arvensis*), which differs from the other mustards in having a large stout beak at the end of the pod. In addition to the use of mustard as a condiment and medicine, the leaves are used for greens or in salads. In planting oats or wheat, great care should be taken to see that the grains are free from mustard seeds, and the seed should also be sown on clean fields such as have been in pasture or meadow and not previously inhabited by mustard. If, in spite of all precautions, some mustard should come up, it may be sprayed with iron sulphate. One of the chief reasons why mustard is so bad in grain fields is that it is usually harvested with the grain. The plants are about the same height as the grain and the seeds often mature at the same time, making the process of extermination particularly difficult.

GOOSEFOOT FAMILY

Chenopodiaceae

This family consists chiefly of herbs which are more or less succulent. The flowers are small and inconspicuous and usually have a greenish color. The most common members of the family are weeds. However, several important economic plants are members of this family, for example, spinach, beets, and Swiss chard. The members of the goosefoot family are especially common in desert regions, particularly in salty deserts. They have a high degree of tolerance of salt in the soil. The Russian thistle, one of our worst weeds, is native in salt deserts but is spread widely in dry land.

GOOSEFOOT OR LAMB'S-QUARTERS

PAGE 539

Chenopodium album

DESCRIPTION: Erect annual, 1 to 4 feet high; flowers, green, in clusters; disposed in dense, spiked panicles; leaves, ovate to lanceolate and covered with a more or less mealy coat.

DISTRIBUTION: Throughout North America, except in the extreme north. Naturalized from Europe.

The weed gets both its scientific name and its common name, goosefoot, from the shape of the leaves. Although the goosefoot, or lamb's-quarters, is known mostly as a pest in gardens and fields, like the dandelion it is often used for food. Delicious greens and soups may be made from it. It is also the favorite food of hogs. Each branch produces an enormous number of seeds so that it may be best exterminated before the seeds mature.

GRASS FAMILY

Gramineae

This is almost the largest of plant families and is by all means the most useful of them all. There are several thousand different species of grasses and they are widely distributed throughout the world. Grasses furnish the most important plant foods for man and animal. All the true cereals—wheat,

corn, oats, rye, barley, rice, etc.—are grasses. Sugar cane, sorghum, and other grasses yield sugar, while innumerable small grasses furnish pasturage for animals. Blue grass, timothy, redtop, and orchard grass are well known and are important grasses valuable for animal food. On the western ranches, grama grass, buffalo grass, wheat grass, and many others are important for range animals. One of the most useful of all plants where it grows, is the bamboo, which also is a grass. The grass family also includes a number of very bad weeds, such as the sandbur, crab grass, barnyard grass, quack grass, old witch grass, foxtail, and many more. All of the grasses except the bamboos may be called herbs. Usually grasses have hollow stems with prominent closed joints or nodes. The leaves are sheathing and the flowers are rather inconspicuous. Usually the flowers are perfect. Petals and sepals in this family are replaced by chaff-like bracts known as *glumes*.

SANDBUR

Cenchrus carolinianus

DESCRIPTION: Annual herb, usually less than 1 foot high; flowers, greenish, growing later into a very characteristic bur, which bears stout and exasperating spines.

DISTRIBUTION: Common throughout most of the United States.

The sandbur is often a very common and undesirable weed. It is somewhat easily exterminated, especially by cultivation, if the plants are not allowed to go to seed. Exposure of the roots to the sun for a short time destroys the plant.

FOXTAIL GRASS

PAGE 539

Setaria glauca

DESCRIPTION: An erect annual, 1 to 2 feet high; spikes, bristly, cylindrical, 1 to 3 inches long; leaves, flat.

DISTRIBUTION: Generally distributed throughout the United States. Naturalized from Europe.

There are two common species of foxtail grass, *Setaria glauca*, which is called pigeon grass, and *Setaria viridis*, also called bottle



Crab Grass

Yellow Foxtail Grass

Wild Mustard (Charlock)

Goosefoot

grass. Pigeon grass differs from bottle grass in its yellow bristles, those of the bottle grass being green. A very close relative to the foxtail is the cultivated Hungarian grass, often called millet, although the true millet of antiquity was quite a different grass.

To exterminate foxtail, the field should be plowed as soon as the grain is removed. This will prevent the production of a large amount of seed on the part of the weeds. In the spring the field should be harrowed and planted to corn, which should be cultivated as frequently as possible.

CRAB OR FINGER GRASS

PAGE 539

Digitaria sanguinalis

DESCRIPTION: Annual, 1 to 3 feet high, with greenish flowers in long, slender spikes.

DISTRIBUTION: In cultivated and waste places throughout North America, except the extreme north. Naturalized from Europe.

These weedy grasses get their name from the fact that their spiked flowers look like slender fingers. This plant is a very bad weed and is somewhat hard to exterminate because it roots readily at the joints, causing it to spread very rapidly. It has been used as a forage plant, but generally it is regarded as a pest.

FIGWORT FAMILY

(See Page 528)

BUTTER AND EGGS OR TOADFLAX

PLATE 5

Linaria vulgaris

DESCRIPTION: Perennial herb, $1\frac{1}{2}$ to $2\frac{1}{2}$ feet high; flowers in racemes, yellow and orange.

DISTRIBUTION: In fields and waste places from Newfoundland to Oregon, Virginia, and New Mexico. Naturalized from Europe.

This plant owes its common name of butter and eggs to the combination of yellow and orange in the flower. The name toadflax comes from the resemblance of the leaves to those of flax. Many other names are applied to this plant, such as wild snap-

dragon, which is not such a bad name, since this plant is closely related to the cultivated snapdragon of our gardens. The butter and eggs might be classed as a weed, but is usually not a very serious pest. It is even quite a desirable asset, because it brightens up and makes beautiful many of the ugly spots along our roadsides and near our dwellings. It almost seems to enjoy spots made ugly through human agency.

The flower is so constructed that the bumblebee is practically the only insect that can reach its nectar. When the bee alights upon the lower lip of the flower, its weight causes the door of the flower to open. The bee sticks its tongue deep down into the nectar cup, at the same time receiving a dusting of pollen and depositing some of that received from a flower previously visited. Then the insect backs out to fly away to another flower and the door closes after it. The honeybee and other insects of lighter weight are unable to open the doors.

Toadflax has many seeds which cause the species to spread widely and rapidly. If it ever becomes abundant enough to be undesirable, it can be got rid of by thorough cultivation and crop rotation.

MULLEIN

PAGE 542

Verbascum thapsus

DESCRIPTION: Tall, woolly biennial herb, 2 to 6 feet high; flowers, yellow on a dense spike.

DISTRIBUTION: From Nova Scotia across North America, southwest to Kansas and Utah. Naturalized from Europe.

The woolly or velvety appearance of the plant is the first thing noticed about the mullein. The plant-surface is covered by minute interlacing hairs which keep down the evaporation of water and also enable the plant to withstand severe cold in winter. The hairs are very stiff and bristly and thus protect against animals. The large light-green leaves form a rosette, from which in the second year there develops a tall, erect stem with a long, dense spike of flowers.

The ancient Romans dipped the stalks in suet and used them as torches in their processions. The Greeks soaked the leaves in oil and used them as wicks in their lamps, and in the Middle Ages many people used them as candlewicks. Mullein is reputed to



Right photograph by E. L. Crandall

Common Plantain



Courtesy, Wild Flower Preservation Society

Common Mullein

have medicinal properties, especially in the treatment of coughs and colds. Country girls have found that when they rub their cheeks with mullein a rosy color is produced, better than that of rouge.

Mullein is easily destroyed by cutting the plant off a few inches below the surface of the ground. It spreads entirely by seed and, therefore, should be cut or pulled before the plant matures.

PLANTAIN FAMILY

Plantaginaceae

The plantain family consists chiefly of stemless herbs with ribbed leaves and regular flowers in long terminal spikes.

PLANTAIN OR RIBWORT

Plantago major

DESCRIPTION: Perennial, with broad, prominently ribbed leaves and small greenish flowers forming an elongated spike.

DISTRIBUTION: Widely distributed throughout North America.

This very common weed has a rosette of broad, thick leaves from which arise stalks bearing small greenish flowers, which are pollinated by the winds. The seeds are much sought by birds, which aid in scattering them. According to an old tradition, toads ate the leaves and were thus protected from the poisons of insects that bite and sting. Both Indians and white men have used the leaves to reduce swellings which are caused by bee stings. The Indians called the plantain "white man's foot."

Careful cultivation will keep plantain in check in the field. On the lawn, where it is especially troublesome, a teaspoonful of salt applied to the crown of small plants in warm weather will kill the plantain without injuring the grass.

PARSLEY FAMILY

Umbelliferae

This large family of herbs owes its scientific name to the fact that most of its members have small flowers in umbrella-like clusters known as umbels. The parsley family includes parsley, carrots, parsnips, celery, fennel, caraway, and anise; and also the medicinal plant, asafoetida. There are many poisonous plants in this family as well as plants that are edible and good. The poison hemlock is perhaps the best-known poisonous member of the group, but there are a number of others, and it is unwise for one to taste a member of this family unless he is sure of what he is eating.

WILD CARROT

PLATE 5

Daucus carota

DESCRIPTION: Biennial from 2 to 2½ feet high; leaves, compound; flowers in umbels, white, but with the central flower in each umbel usually dark purple.

DISTRIBUTION: Common in eastern North America, especially in dry fields. Naturalized from Europe.

Farmers and cattle-raisers consider the wild carrot as one of the worst of weeds. Flower-lovers, on the other hand, admire the lacy blossoms and have given to this plant the name Queen Anne's lace. The wild carrot has a deep, fleshy root. It has been proved

that this weed is an ancestor of the table carrot—one of the best illustrations of producing something good from a pest.

The wild carrot spreads only by seed, and hence is easily exterminated by cutting the plant before the season is over.

PINK FAMILY

Caryophyllaceae

The pink family contains the pinks, which are the ancestors of the cultivated carnation. The sweet William is also a colorful, old-fashioned flower belonging to this family. A number of weeds, especially chickweed, catchflies, and corn cockle belong to this family. Chickweed and corn cockle are especially troublesome.

This family is characterized by opposite leaves which arise from the swollen nodes of the stems. It has a very striking similarity to the phlox family (see p. 495). It is different from it in the fact that the petals are separate instead of grown together. The common wild phlox is often called wild sweet William because it so often resembles the true sweet William of the pink family.

BOUNCING BET OR SOAPWORT

PLATE 5

Saponaria officinalis

DESCRIPTION: Perennial herb with clusters of whitish-pink flowers.

DISTRIBUTION: Widely distributed throughout the United States, having escaped from old-fashioned gardens where it formerly was much cultivated as an ornamental introduced from Europe.

Bouncing Bet is a vigorous and profusely flowering plant, whose flowers have a mild fragrance somewhat suggesting its relation to the pinks. It was brought from Europe and planted by our great-grandmothers and still graces old-fashioned gardens. It has the capacity for multiplying rapidly and is sometimes considered a weed. However, it may be regarded as more of an asset than a liability, because it beautifies waste places and ugly spots along the roadsides.



PLATE 5.

Wild Carrot
Fringed Gentian
bud and flower

© Painted from living plants expressly for THE CLASSROOM TEACHER

Butter and Eggs

Bouncing Bet
Wild Aster
leaf and flower



PLATE 6.

Low or Pasture Rose
flower and fruit
Arrowwood (fruit and flower)

© Painted from living plants expressly for THE CLASSROOM TEACHER

Gooseberry

Mountain Blackberry
flower, leaf and fruit
Flowering Dogwood

Both the common name, soapwort, and the scientific name, *Saponaria*, refer to the fact that the bruised stems, leaves, and roots when soaked in water yield a slippery substance formerly used as a soap. Even now it has its value in this respect and is used in taking grease spots out of woolen cloth. The roots have also been used in medicine.

It is particularly difficult to exterminate the plant if it ever becomes too abundant.

BUCKWHEAT FAMILY

Polygonaceae

The name "buckwheat" comes from an old German word for beech wheat and is given to members of this family because their triangular seeds resemble tiny beechnuts in shape. In our part of the world, the members of this family are herbs or herbaceous vines. The buckwheat family includes a great number of common weeds, such as the sorrel, described below, the docks, the knotweeds, and the smartweeds. Also included here are two important cultivated plants, buckwheat and rhubarb.

FIELD OR SHEEP SORREL

Rumex acetosella

DESCRIPTION: Perennial low herb only a few inches in height; flowers, small, reddish, in terminal panicles; male flowers and female flowers on separate plants.

DISTRIBUTION: In dry fields and on hillsides throughout North America except in the extreme north.

The field or sheep sorrel, also known as sour grass or sour dock, may be distinguished by its arrow-shaped leaves and by its sour taste. It is not welcomed by the farmer because it crowds out wheat and valuable grasses in cultivated fields. In one respect it is very valuable to the farmer because its increase indicates that the land is getting sour and should, therefore, be attended to by liming or otherwise.

On account of its perennial nature and its rapidly spreading rootstocks, it is rather difficult to exterminate.

CULTIVATED PLANTS

ROSE FAMILY

(See Page 504)

APPLE

PAGE 547

Pyrus malus

DESCRIPTION: Trees with clusters of pink and white flowers and round fleshy fruit.

DISTRIBUTION: Native of southwestern Asia, now widely cultivated in all temperate regions.

The relationship between the apple and the wild rose may be seen in the shape of the five-petaled flower and the numerous stamens; and also in the character of its fruit. The apple blossom is well adapted to insure cross-fertilization. The stigmas reach maturity before the anthers begin to shed their pollen. The apple blossom is the state flower of Arkansas and of Michigan.

The apple is a remarkable example of what careful selection and cultivation may accomplish in the plant world, for the many highly developed varieties of apples which we now cultivate have come from quite a humble wild ancestor whose acid fruit was of very little value. In America, the apple thrives best on clay loam, though it grows on a great variety of soils. It will always grow where wheat and corn grow.

The apple came originally from southwestern Asia and the neighboring parts of Europe, but it has been cultivated for so long that we do not know how it began. There is evidence that the prehistoric lake-dwellers of Switzerland ate the fruit.

The bark of the apple tree is a beautiful soft gray and is decidedly scaly. The wood is very fine-grained and heavy and is a favorite wood for wood-carving. It also makes an excellent fuel.

TROPAEOLUM FAMILY

Tropaeolaceae

This family consists of only one genus of fifty species. The name *Tropaeolum* comes from the Greek word for trophy and is very appropriate, for the leaves are shield-shaped and the flowers are helmet-shaped.



Apple Blossoms

Nasturtium

NASTURTIIUM

Tropaeolum

DESCRIPTION: Annual or perennial herbs with soft, more or less succulent stems, and alternate leaves; flowers, solitary, irregular, commonly orange.

DISTRIBUTION: Native of South America, widely cultivated for ornament.

The nasturtium is one of the most popular of cultivated plants and it is easily grown in any sunny, moist place. There are five sepals, one of which is produced into a long slender nectar spur. Usually there are five petals which are narrowed into distinct claws. Two upper petals are usually smaller and unlike the others, and are inserted at the opening of the spur. The colors of the flowers are exceedingly brilliant. The leaves, which are almost round, are bright green above but very pale beneath. The flower buds and seeds are sometimes made into pickles. The peppery-tasting leaves are used in salads.

The cultivated nasturtium has no relation to the wild nasturtium of the mustard family.

FALL FLOWERS

COMPOSITE FAMILY

(See Page 513)

WILD ASTER

PLATE 5

Aster

DESCRIPTION: Perennial herbs with yellow disk flowers and white, pink, blue, or purple heads.

DISTRIBUTION: Widely distributed throughout the United States and southern Canada.

The aster, like the goldenrod, is especially common in the late summer and autumn. While nearly all the goldenrods are yellow in color, the aster never is, though it may vary in shade from white through pink to blue and purple. The disk flowers are yellow as in the goldenrod, but the main color of the heads is given by the ray flowers. It is from these ray flowers that the aster gets its name, which means "star." One of the most beautiful of the asters is the New England aster (*Aster novae-angliae*), which is found not only in New England but also from Quebec to Saskatchewan and south to the Gulf of Mexico. The heads are from one to two inches across, the rays generally of a deep violet-purple color. This species grows in fields and meadows. The tall white or panicked aster (*Aster paniculatus*) is a much-branched species having white or purplish flowers in loose panicles. It is found chiefly in wet meadows and thickets. There are many other varieties of aster found in the United States and southern Canada, some growing in woods, others in fields, swamps, and in open dry situations.

GOLDENROD

PAGE 549

Solidago

DESCRIPTION: Perennial herbs with wandlike stems and small yellow flower heads in racemes or clusters.

DISTRIBUTION: Widely distributed, chiefly on open ground.

The goldenrod is one of the most graceful and beautiful of all our summer wild flowers. It is a thoroughly American plant, most



Right photograph by H. S. Barber
Canada Goldenrod



Courtesy, Wild Flower Preservation Society
Cardinal Flower

of the eighty or more species being natives of the United States. It is the state flower of Nebraska and Alabama and there has been much talk of making the goldenrod the national flower of the United States. No flower would be more characteristic of all the states in the Union than this.

The goldenrod is especially characteristic of the late summer and autumn. The flowers, both of the disk and of the ray, are yellow with very few exceptions, and are borne in racemes or clusters. By many, the goldenrod is associated with hay fever, and perhaps correctly, although it is probably true that most hay fever is caused by ragweeds and other plants whose pollen blows around much more readily than does that of the goldenrod.

There are many kinds of goldenrod, most of which look more or less alike to the layman, although even the amateur in botany may immediately recognize the difference between those with flat-topped inflorescences and those in one-sided racemes. The great majority of goldenrods belong to the latter category. Some of the species grow in woodlands, but the majority of them are found in open grounds along the roadsides and in prairies and meadows where the soil is dry.

GENTIAN FAMILY

Gentianaceae

This is a family of herbs with colorless bitter juice. It gets its name from King Gentius of Illyria, who is said to have discovered the medicinal properties of these plants. The gentians are smooth herbs with opposite, sessile, entire, simple leaves without stipules. The flowers are regular and the stamens as many as the lobes of the corolla. The family includes about seven hundred species and is widely distributed.

FRINGED GENTIAN

PLATE 5

Gentiana crinita

DESCRIPTION: Leafy stem, 1 to 3 feet high; flowers, bright blue, bell-shaped.

DISTRIBUTION: Meadows and moist ground from Maine to Quebec, west to Dakota, and south to Georgia. Related species occur in the Yellowstone National Park and in the western mountains.

The fringed gentian is perhaps the most prized of the autumn flowers because of the marvelous beauty of its bell-shaped flowers. The petals are a deep blue in color and are beautifully fringed. They open only in the sunshine. There is no flower more in need of preservation than this, because it propagates only by seed. Every flower produces a very great number of very small seeds, and every flower that is picked deprives nature-lovers of an abundance of flowers the following year. The gentian is also very sensitive to changes of surroundings. Draining operations and other things that attend human progress are oftentimes fatal to the gentians.

The closed gentian (*Gentiana andrewsii*) is known for its tightly closed bottle-shaped blue flowers which turn purple with age. These flowers generally remain closed, although they sometimes open, particularly as they become old. However, the bumblebee is able to force its way into the closed corolla and feast upon the nectar. The distribution of the closed gentian is very much the same as that of the fringed gentian, both species occurring especially in low grounds where there is little or no shade.

LOBELIA FAMILY

Lobeliaceae

This family consists chiefly of herbs with acrid milky juice, alternate leaves, and irregular flowers. Some of the members of the family, such as the Indian tobacco (*Lobelia inflata*), are characterized by their narcotic poison.

CARDINAL FLOWER

PAGE 549

Lobelia cardinalis

DESCRIPTION: Stem from about 2 to 4 feet high, with alternate narrow oblong leaves and racemes of bright red flowers.

DISTRIBUTION: In swamps from New Brunswick to Colorado and south to Florida and Texas.

This brilliant red flower is the most striking member of the lobelia family and is one of the most gorgeous of the wild flowers. It is in special need of protection by wild-flower lovers because it spreads entirely by seeds. It is quite futile, also, to take the cardinal flower from its native home, because it quickly wilts and does not recover.

The five petals of the corolla are united into a long tube, as are also the long stamens. The pistil has a fringed stigma. The cardinal flower is especially attractive to humming birds, which are able to reach down into the long nectar cup with their long bills.

DESERT PLANTS

GOOSEFOOT FAMILY

(See Page 537)

GREASEWOOD

Sarcobatus vermiculatus

DESCRIPTION: A stiff branching shrub with fleshy leaves and spines; flowers, without bracts; male and female flowers, quite different in character.

DISTRIBUTION: In dry alkaline soil, in Nebraska and Wyoming and southward to New Mexico.

Greasewood is one of the few shrubs that belong to the goosefoot family. It reaches a height of from two to ten feet. It is either dioecious—that is with the male and female flowers on different plants—or monoecious—that is with the male and female flowers opposite each other on the same plant.

The roots penetrate deeply and bring considerable quantities of alkali to the surface. Cattle and sheep eat the leaves of the greasewood and browse off the small stems. The greasewood has long been used in the arid West as an indicator of salty soil, and farmers have avoided settlement in those sections where the greasewood predominates. It is thus very useful to men in telling them what places to avoid for settlement.

LILY FAMILY

(See Page 488)

YUCCA

PAGE 555

Yucca

DESCRIPTION: Large plants with stiff, lance-shaped leaves; stem, tall, slightly branched in some species and not at all in others; flowers, beautiful, large, numerous, and white.

DISTRIBUTION: Chiefly in the southwest of the United States and in Mexico.

The yucca is a striking plant, not only in the arid regions where it naturally grows, but also in gardens. The leaves are crowded in tufts at the end of the stem or branches. The name yucca comes from the Spanish word for bayonet and the common eastern species of this plant is often known as Spanish bayonet. The leaves remain green through the winter. The yucca of the Southwest, often known as the Joshua tree, has a tall, much-branched stem covered with leaves which remain on the tree long after they are dead. Small species of yucca, not at all treelike, occur in the prairies and also in the southeastern states.

The relationship between the yucca and the yucca moth is one of the greatest marvels of nature. The moth gathers pollen from the yucca blossoms and forms it into a ball. This she pushes down the hollow center of the pistil, after having laid an egg in the pistil where it will come in contact with the pollen. Thus the moth sets seed for the yucca and the yucca makes it possible for the moth to

produce young by living upon the developing fruit of the yucca plant.

A coarse fiber is obtained from the stem and leaves of the yucca and used to some extent for cordage. The leaves of some species are woven into baskets, mats, etc. The roots yield a substance which is used in place of soap, hence the name soap plant used in some sections. A closely related species known as the bear grass is one of the most attractive plants of the northern Rockies.

POPPY FAMILY

(See Page 484)

MEXICAN POPPY

PAGE 555

Argemone mexicana

DESCRIPTION: Herb with spiny-toothed leaves and thorny stems, with yellow, cream-colored, or white flowers.

DISTRIBUTION: Native of tropical America, where it is a common weed, now naturalized in waste places from Massachusetts to Texas. A closely related species is found native in the arid Southwest.

Like many of the plants of the arid countries, this plant is well protected with sharp spines, hence it is often known as prickly poppy or thorn poppy. Although a native of the tropics, it seems to be able to carry on successfully as far north as New England.

The leaves are usually blotched with white. The flowers, measuring about two inches across, have from four to six golden-yellow or cream-colored petals and yellow stamens. The western prickly poppy has very delicate pure white petals. The fruit capsules are nearly an inch long and are well armed with spines. The oil of the seeds is used in painting.

CACTUS FAMILY

Cactaceae

No plant is more characteristic of the American desert than is the cactus, which has developed one of the most remarkable and satisfactory ways of accumulating and storing water possessed by any plant. The cactus does not root

deeply in the soil, but has numerous roots which spread out and quickly absorb the water that falls in the rainy seasons. This water is stored in the stem, which is thick and fleshy. The stem also is covered with a thick skin which reduces evaporation to an almost negligible degree. The stored-up water serves to tide the cactus plants over long periods of drought.

The cacti have no conspicuous leaves, and during much of their life have no leaves at all. They are, however, abundantly covered with spines, which are often pointed or hooked and otherwise disagreeable to one who comes too close to them.

There are about one thousand species of cacti, mostly distributed in the arid regions of North and South America. Some species, known as prickly pear (*Opuntia*), extend north as far as Michigan and Alberta.

GIANT CACTUS

PAGE 555

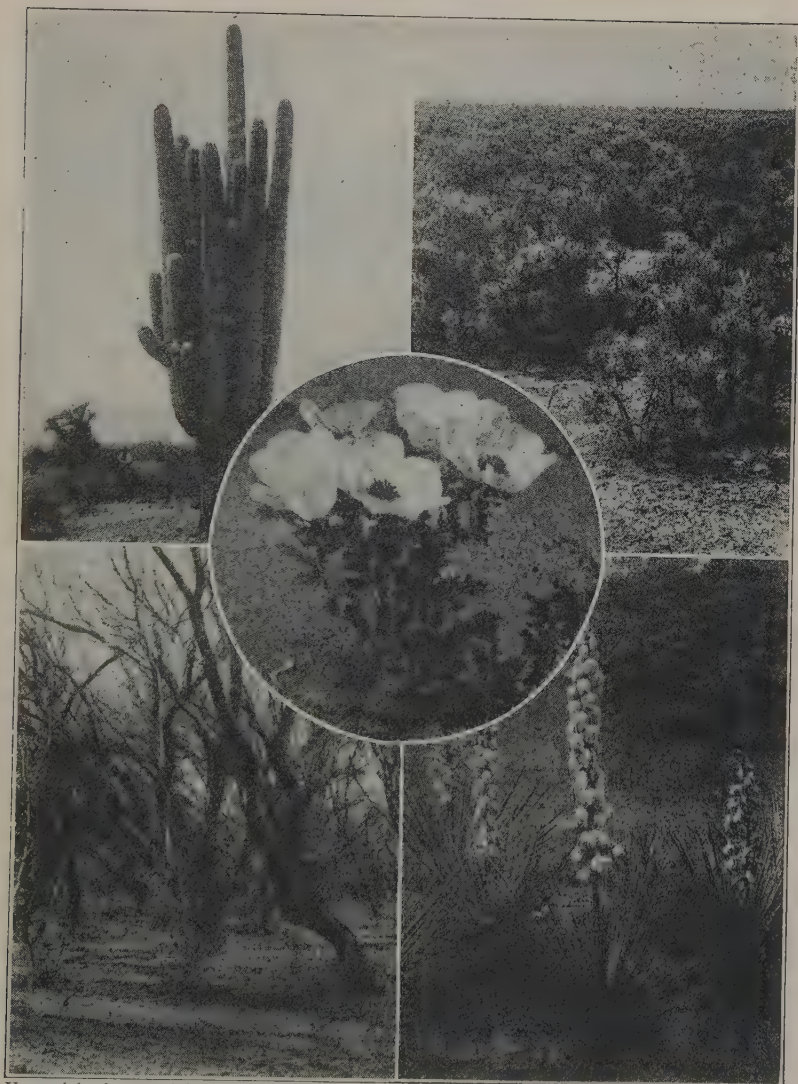
Cereus giganteus

DESCRIPTION: Stem, thick and cylindrical, simple and upright or with one or two branches; rows of spines in star-shaped formations; flowers, large, white, waxy.

DISTRIBUTION: Arizona, southeastern California, and Sonora, Mexico.

One of the largest and most interesting of all cacti is the giant cactus, which has thick cylindrical, fluted stems that open and shut like an accordion with changes of moisture. They expand after a rain and contract during drought. The stem is erect or simply branched and is armed with rows of spines. The fruit is edible, as is the case in most cacti. This cactus sometimes reaches a height of forty feet. Although countless seeds are produced, very few mature. In May and June the plant bears exquisite whitish waxlike flowers, which open in the daytime.

In spite of the sharp spines of the giant cactus, which serve to protect the plant from animal destruction, woodpeckers make holes in the stems for their nests and, later, owls and other birds use these same holes for their nesting places. The giant cactus is the state flower of Arizona.



Upper left photograph by Southern Pacific R. A.

Lower right photograph by E. L. Grandall

Courtesy, U. S. Forest Service
Courtesy, Wild Flower Preservation Society

Giant Cactus

Sagebrush

Mesquite

Mexican Poppy

Yucca (Adam's Needle)

Yucca filamentosa

COMPOSITE FAMILY

(See Page 513)

SAGEBRUSH

PAGE 555

Artemisia tridentata

DESCRIPTION: Aromatic shrub; leaves, gray-green, alternate; flowers, numerous, yellowish- or greenish-white.

DISTRIBUTION: On dry plains and in rocky soil from western Nebraska to California and from British Columbia south to Mexico.

This is one of the most abundant plants in the western desert country. For many miles in some of the arid regions in the West the sagebrush may be practically the only vegetation seen. It may be recognized by its silvery appearance and its pungent odor, suggesting the aroma of cultivated sage. It is the state flower of Nevada.

Closely related to the sagebrush and of the same division of the composite family is the wormwood, which derives its common name from its use as a remedy for intestinal diseases. Various kinds of wormwood are used for making the French liquor known as absinthe.

Sagebrush is an almost certain indicator of fertile land, and since the days of the Utah pioneers it has been used to indicate places where one might settle and grow crops. However, the rainfall in these places is usually insufficient for ordinary crops, so that the land must be irrigated. Some of the most valuable lands in the western states are those once occupied by sagebrush.

PULSE FAMILY

(See Page 498)

MESQUITE

PAGE 555

Prosopis juliflora

DESCRIPTION: Tree or shrub having irregular or crooked branches, compound leaves, and small greenish-white fragrant flowers.

DISTRIBUTION: Southern United States from Texas west, and south through Mexico and the Andean region to Chile and the Argentine Republic.

Mesquite is able to grow in some places where no other large woody plant can exist. This is made possible by the remarkable development of its root system, which descends to a great depth and does not branch or decrease much in diameter until water is reached. It thus serves as an indicator of water level and on this account is a very valuable plant for the pioneer. When it grows to the height of a tree, water may be found comparatively near the surface. When it is only a shrub, water is to be found only at a great depth, often as much as fifty or sixty feet below the earth's surface.

While the mesquite tree would not be considered as much of an asset in some regions, it is considered a great asset in the regions where it grows, because it is about the only thing available for fuel, fence posts, and the like.

Mesquite belongs to the same family as the peas and beans, and the relationship may readily be seen in the characteristic pods and leaves which are much like other members of the legume or pea family. The Mexicans and Indians use the pods as food.

FERNS

FERN FAMILY

Polypodiaceae

The ferns belong to the division of the plant kingdom known as *Pteridophytes*. The plants of this order have no flowers and do not bear seeds, but reproduce by means of spores. Most ferns belong to the family of *Polypodiaceae*. They have delicately cut leaves often known as fronds. These show the greatest variety in size and form and many of them are very beautiful. If in midsummer one looks on the underside of most ferns, one will find brown spots, often covered by thin, whitish membranes. These are called fruit dots or *sori*. The word *sorus* (plural, *sori*) means "heap," and each of these little dots is a small cluster of *sporangia*. These sporangia are the structures that bear the spores, countless tiny grains, each one a single plant cell and capable of producing a new fern.

MAIDENHAIR FERN

PAGE 561

Adiantum pedatum

DESCRIPTION: Leaflets, very delicate and wedge-shaped, borne on slender, dark shining stalks; spores borne in sori along the leaf margins.

DISTRIBUTION: In rich moist woods from Nova Scotia to Alaska, south to Georgia and Kansas, and west, Rocky Mountains to Utah and California.

The dainty maidenhair fern takes its name from the hairlike appearance of its fine dark stems. At first the stems are covered over with a waxy substance known as bloom, but later they appear polished and are dark brown to black in color.

The name *Adiantum* comes from a Greek word meaning "unwettable" and was given to this fern because rain and dew roll off the stems without wetting them. This is true of many plants of the woods and is a great help to them because it keeps the pores of the leaflets open and free to carry on respiration and other similar processes. If the delicate pores were not cleansed they would become clogged and the plant would suffocate.

BRAKE OR BRACKEN

PAGE 561

Pteris aquilina

DESCRIPTION: Coarse fern, generally with three branches at the top of an erect stalk; spores in sori along the leaf margin.

DISTRIBUTION: In thickets or open woods throughout most of North America as well as other continents. This is the most widely distributed fern in the world.

The brake or bracken is one of the most familiar inhabitants of oak woods and similar situations that are not too dry. It has a very long creeping rootstock which goes deep into the soil. This rootstock sends up branches at frequent intervals and grows so rapidly that stretches of ground are quickly covered over. The leaf may often be two or three feet tall and in the western forests it may reach a height of ten or fifteen feet. Unlike most ferns, this species may invade pastures and become indeed a veritable nuisance to the owner of the land by crowding out the succulent grasses. In some places the brake is used as bedding for cattle. People sometimes boil the rootstocks for food.

CHRISTMAS FERN

PAGE 561

Polystichum acrostichoides

DESCRIPTION: Fronds, lance-shaped, 1 to 3 feet high, evergreen; in tufts at end of stout rootstock.

DISTRIBUTION: In woods and on wooded hillsides, especially in rocky places, from Nova Scotia to Ontario and Wisconsin and south to Texas and the Gulf states.

The Christmas fern is well named, for its firm thick fronds retain their dark glossy green color all winter and are much used in holiday decorations. It is also one of the earliest ferns to come up in the woods in spring.

FLOWERING FERN FAMILY

Osmundaceae

This family is very different from the family of true ferns, since the parts of the frond are reduced to little more than the veins and on these the spore cases are borne in thick clusters. They are round and are much larger than the sporangia which are found on the underside of the frond. These clusters are not unlike the seed vessels borne on some flowering plants. To this family belong the royal fern, the cinnamon fern, and the interrupted fern.

CINNAMON FERN

PAGE 561

Osmunda cinnamomea

DESCRIPTION: Sterile fronds, large, coarse, clothed with rusty wool when young; fertile fronds, covered with cinnamon-colored sporangia, hence the name.

DISTRIBUTION: In wet woods and swamps from Newfoundland to Minnesota and south to the Gulf and New Mexico; also in South America and Asia.

When the young cinnamon ferns begin to uncoil in the spring they somewhat resemble the head of a violin or fiddle and are sometimes called fiddle heads. They are covered with a thick woolly covering which falls off when the fern matures, but little tufts of it remain where the leaflets join the stem.

HORSETAIL FAMILY

Equisetaceae

The horsetail family belongs to the same great division of plants as do the ferns. Like the ferns they reproduce by spores and are without true flowers. The plants have jointed, hollow stems. There is only one genus of this family in our modern world, namely, *Equisetum*. This includes the common horsetail and the scouring rushes. In that long-gone period called the Carboniferous or Coal Age, the horsetails were a large and important group of plants. Some of them were trees growing in dense forests and attained a height of from sixty to ninety feet and a girth of three feet. Even the largest horsetails today are merely herbs of small size, which give only a dim notion of the luster of the past representatives of this group.

HORSETAIL

PAGE 561

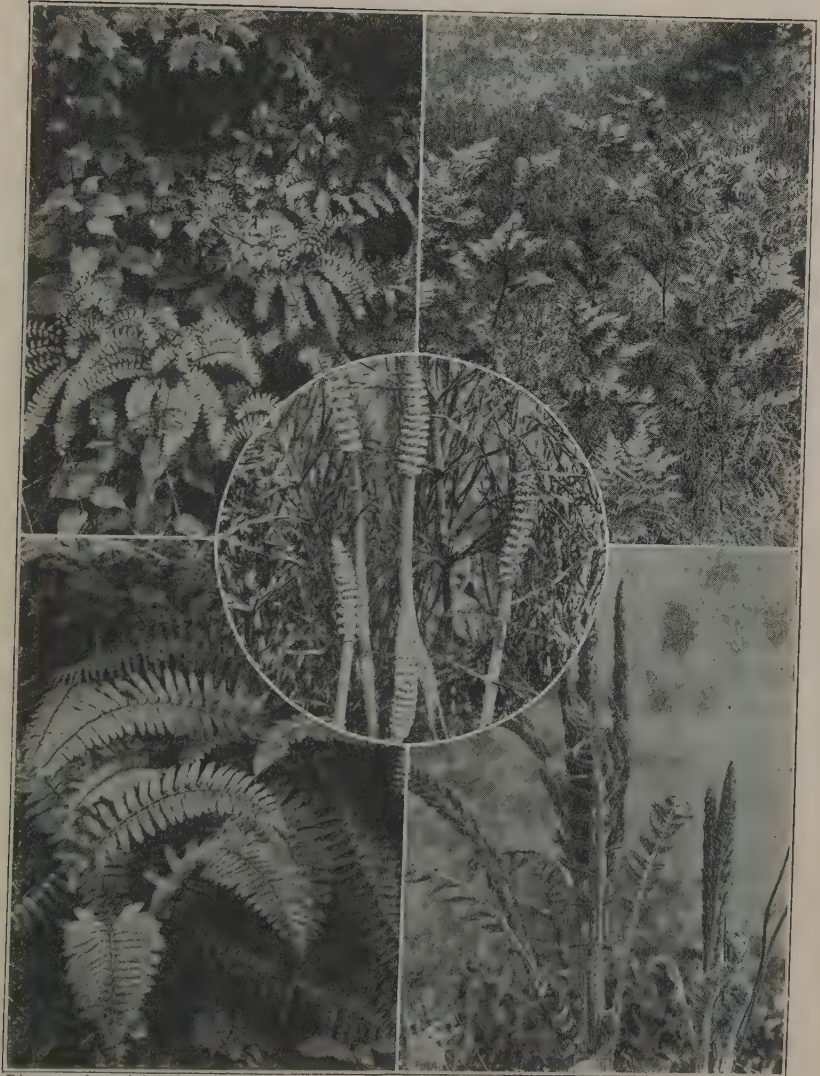
Equisetum arvense

DESCRIPTION: Rushlike plant with jointed, sometimes branched, hollow stem; fruit, a terminal cone somewhat resembling the flower of a pine, composed of shield-shaped scales which bear spores on the undersurface.

DISTRIBUTION: In sandy soils from Greenland to Alaska and southward to Virginia and California.

The horsetails of today are very different from their forebears of prehistoric times. Seldom now do they reach a height of more than two feet. They are readily identified by their jointed stems. One joint fits into the next so that they can be easily pulled apart. The branches coming from the main stems look like horses' tails, which accounts for the common name. Some related species, especially the scouring rush (*Equisetum hyemale*), are used for scouring and polishing. The fact that the stems are impregnated with silica helps to make them more effective cleaners and polishers.

Both the scouring rush and the common horsetail are very common in sandy places and on railway and other embankments.



Photographs at left by Paul Bartsch
 Photograph at upper right by E. L. Crandall

Courtesy, Wild Flower Preservation Society
 Courtesy, Wild Flower Preservation Society

Maidenhair Fern

Christmas Fern

Horsetail

Common Brake

Cinnamon Fern

VINES

GRAPE OR VINE FAMILY

Vitaceae

This family consists of woody vines, usually climbing by means of tendrils. The leaves are alternate and have tendrils or clusters of small greenish flowers opposite them. The Virginia creeper, Japan or Boston ivy, and many species of grape are the best-known members of the family.

VIRGINIA CREEPER

PAGE 565

Psedera quinquefolia

DESCRIPTION: Perennial, woody climber with 5-parted leaves and inconspicuous greenish flowers; fruits, small and grape-like but with very little flesh.

DISTRIBUTION: In woods and thickets from Quebec south to Florida and Mexico.

The Virginia creeper or woodbine is such an attractive and vigorous plant that it has been brought widely into cultivation, frequently being made to climb on porches, fences, and walls. It sends out tendrils by means of which it is able to secure a firm foothold.

The Virginia creeper somewhat resembles the poison ivy, the latter, however, having three-parted leaves. In the autumn the leaves of the Virginia creeper turn bright red, so that the vines give one of the most brilliant touches of color to our woodlands at that season.

GRAPE

PAGE 565

Vitis

DESCRIPTION: Leaves, simple, rounded or lobed, more or less heart-shaped; flowers, greenish and inconspicuous, but deliciously fragrant.

DISTRIBUTION: Most of our wild species are widely distributed.

The most useful of our native grapes is *Vitis labrusca*, often called the northern fox grape. This species is characteristic of

thickets from Vermont to Indiana, Georgia, and Tennessee, and is the ancestor of many of our famous grapes such as the Concord, Catawba, and Isabella. The young branches and leaves of this species are of a rusty color and very woolly. This woolliness persists on the underside of the leaves until they are very old. The flowers appear in panicles in May or June. The grapes ripen in September or October and are dark purple or amber in color with a tough, musky pulp. Although the cultivated grapes derived from this species are of especial importance to man, the grape even in its wild state has many important uses. The frost grape (*Vitis cordifolia*) and the river grape (*Vitis vulpina*) have smaller berries, which are black and shiny. They usually grow in large clusters with many grapes in a cluster. Both of these species grow in moist thickets and along streams throughout most of the eastern United States.

STAFF-TREE FAMILY

Celastraceae

This family of trees, shrubs, and woody vines includes the strawberry bush and the burning bush or wahoo and others, as well as the bittersweet, which is described below.

BITTERSWEET

PAGE 565

Celastrus scandens

DESCRIPTION: Woody, twining vine with alternate leaves and small greenish or cream-colored flowers and very showy bright orange berries.

DISTRIBUTION: Usually in rich soil from Quebec to Manitoba and south to North Carolina and New Mexico.

Bittersweet is best known by its very showy fruit. The flowers, which appear in June, are small and inconspicuous and without fragrance. The berry-like capsules, which ripen in September, are bright orange and are still prettier when they burst and show the scarlet within. The berries remain on the stems all winter. They are eaten by the birds, and thus the seed is scattered. The bittersweet is so popular for winter decorations that it has been found necessary in many cases to protect it against extermination.

CASHEW FAMILY

Anacardiaceae

This family consists of trees or shrubs having an acrid juice, resinous in some and milky in others. A number of tropical plants are members of it, and it also includes some very poisonous shrubby members. Many species produce tannins, resins, lacquers, and varnishes. In addition to the poison ivy, described below, the cashew includes the closely related poison sumac and the other sumacs. All told, it embraces about sixty genera and about five hundred species.

POISON IVY

PAGE 565

Rhus toxicodendron

DESCRIPTION: Vine or shrub with 3-parted leaves; flowers, small greenish, in clusters; berries, whitish or cream-colored and waxlike.

DISTRIBUTION: In thickets and climbing over fences and on trees, from Nova Scotia to British Columbia, Florida, and Mexico.

It is very important for all to know this plant, for every part of it is poisonous to the touch, although some people seem to be immune. Sometimes it appears as a low bush and sometimes as a climbing vine; indeed, it varies so much in habit of growth that many people who know one form of the plant fail to recognize the other. At first glance it seems to resemble the Virginia creeper, but it may always be distinguished in the summertime by its three-parted leaves, contrasted with the five-parted leaves of the Virginia creeper. The leaves of the poison ivy are shining green, short stemmed, and oval pointed. The flowers are yellowish-green and fragrant and are arranged in densely clustered spikes. Toward autumn they develop into waxy-white berries. The poison is an oily, milky juice which causes numerous water blisters that are followed by a burning swelling of the affected parts. When one comes in contact with the poison ivy, the parts that touch it should be washed in hot soapy water. Various remedies have been suggested, one of the best being an alcoholic solution of iron chloride. In severe cases of poisoning, a physician should be consulted.



Upper photographs by E. L. Crandall
Lower left photograph by Martin Carlisle

Courtesy, Wild Flower Preservation Society
Courtesy, Wild Flower Preservation Society

Fox Grape

Virginia Creeper

Bittersweet

Poison Ivy

SHRUBS OF OPEN WOODS AND THICKETS

BIRCH FAMILY

Betulaceae

The birch family consists of trees and shrubs with alternate, simple, straight-veined leaves. The staminate flowers are always in catkins, whereas the pistillate flowers may be either clustered, spiked, or in scaly catkins. The fruit is a one-celled, one-seeded nut.

To this family belong the several species of birch, the hornbeam or ironwood, the hop hornbeams, and the alders, as well as the hazelnut, which is described below.

HAZELNUT

PAGE 573

Corylus americana

DESCRIPTION: Shrub, 6 feet high, leaves, alternate, simple, dark yellow-green; staminate flowers in slender drooping cylindrical catkins; pistillate flowers in starlike crimson tufts projecting above a short scaly bud; nut, ovoid or oblong.

DISTRIBUTION: In thickets or open woods from Maine to Saskatchewan, and south to Florida and Kansas.

The English name hazel comes from the Anglo-Saxon *haesel* meaning a "cap," and the scientific name *Corylus* comes from the Greek *corys* meaning "helmet." Both of these names refer to the helmet-like covering of the fruit. The fruit resembles the filbert, to which it is very closely related, and has a flavor quite as good. The hazelnut, however, has not been greatly cultivated or used, because of the fact that its fruits are much smaller than those of the filbert, which has been derived from the native hazelnut of Europe and Asia.

In the northern part of the United States and in Canada there is a second species of hazelnut, *Corylus rostrata*. The difference between the two species is most evident in the fruit. The common hazelnuts have an involucre of two broad leaflets with toothed edges and no distinct bracts, whereas the beaked hazelnut has an involucre of united bracts.

CASHEW FAMILY

(See Page 564)

STAGHORN SUMAC

PAGE 571

Rhus typhina

DESCRIPTION: Shrub or small tree with long leaves, having from 11 to 31 leaflets; flowers, green, in distinct clusters; fruit, dull red, covered with bright crimson hairs.

DISTRIBUTION: In dry or rocky soil from Nova Scotia to South Dakota, and along the mountains to Georgia.

The sumac is one of the most attractive of the wild shrubs. The leaves are dark green above and lighter beneath. Late in the season the sumac takes on a bright autumn color, the leaves turning a bright red. In the staghorn sumac the branches and stalks are downy. In the closely related species (*Rhus glabra*), the stalks and branches are smooth. The leaves and bark of the sumac are rich in tannin and are used in tanning leather.

One of the sumac family (*Rhus vernix*) is very poisonous. The leaves of this bush are a beautiful shiny green. They also turn a bright color in the autumn. The berries, however, are greenish-white instead of red and are borne in loose clusters. Fortunately, the poisonous sumac grows only in deep swamps, whereas the other sumacs grow in dry uplands. The poison ivy (see p. 564) is a close relative of the sumac.

BUCKTHORN FAMILY

Rhamnaceae

This family consists of erect or climbing shrubs or even small trees. The family includes various species of buckthorn and also the New Jersey tea. The fruit is a drupe, that is, a hard seed surrounded by a fleshy or pulpy substance. The best known of the buckthorn family is the common *Rhamnus cathartica*, which is much cultivated for ornament and has escaped from cultivation through the agency of birds which scatter the seeds extensively. The family contains some sixty genera, widely distributed.

NEW JERSEY TEA

PAGE 571

Ceanothus americanus

DESCRIPTION: Shrubby plant; stems, rising several together from a deep red root; flowers, white, forming dense panicles at the summit of a naked branch.

DISTRIBUTION: In dry open woods from Maine to Ontario and Manitoba and south to Florida and Texas.

During the American Revolution the leaves of this plant were used as tea on account of the unpopularity of tea derived from British sources.

This is one of the red-root members of the buckthorn family and is itself sometimes called redroot. When in blossom the plant is quite showy by reason of its numerous small white flowers arranged in panicles. The fruit is black and when ripe is dry and splits into three carpels which remain on the plant through the winter. After the seeds have fallen, there remains behind a saucer-shaped receptacle which makes the identification of the plant in winter comparatively easy.

ROSE FAMILY

(See Page 504)

WILD ROSE

PLATE 6

Rosa

DESCRIPTION: Erect or climbing shrubs with alternate, compound leaves, leaflets numbering from 3 to 11; flowers, mostly pink.

DISTRIBUTION: Various species, widely distributed.

The rose has been one of the favorite flowers for many centuries, and is today widely cultivated. It is unsurpassed both for its beauty and its fragrance. Many horticultural productions have been derived from the wild rose of the woods, yet the native wild rose, which is the ancestor of the double roses of the garden, still keeps its delicate charm and by many is loved quite as much as are the cultivated varieties that have been derived from it.

The flowers are large and very delicate, the petals falling off almost at the slightest touch, so that the wild rose is not especially valuable for bouquet purposes.

The seeds are enclosed in a berry-like fruit which becomes red or orange when ripe. The stems are usually lined with prickles. Four states—Iowa, North Dakota, Georgia, and New York—have adopted the wild rose as their state flower.

One of the wild roses (*Rosa blanda*) is without true thorns, although the stems sometimes are covered with prickles. The swamp rose (*Rosa carolina*) is a common and very beautiful wild rose of the swamps. The climbing rose (*Rosa setigera*) is one of the most handsome of the wild roses. It climbs over bushes, and the large clusters of flowers are extremely beautiful.

TALL BLACKBERRY

PLATE 6

Rubus allegheniensis

DESCRIPTION: Tall prickly bush, 2 to 8 feet high; flowers, white in clusters; fruit, black, juicy, edible.

DISTRIBUTION: In dry soil from Nova Scotia to Ontario, Virginia, and North Carolina.

The blackberry is a very familiar wild fruit and is also commonly cultivated in our gardens for its delicious edible fruit. The blackberries and raspberries are alike in having a flower with numerous pistils. Each pistil later develops into a small fleshy drupe, and these grow together on a spongy receptacle.

Raspberries and blackberries differ in that in the blackberry the receptacle comes off with the berry, whereas in the raspberry the receptacle remains on the bush when the berry is picked.

The common high-bush blackberry has showy flowers about an inch in diameter. The leaves are compound and have from three to five leaflets. There are many other species of blackberries in the United States, among which may be mentioned especially the dewberry (*Rubus villosus*), which differs from the preceding in its prostrate habit. The fruit is even more delicious than in the high-bush blackberry and from the common wild dewberry have been derived many of our most important horticultural varieties of blackberries. The familiar loganberry of the West is really a blackberry in spite of its red color and has been derived horticulturally from the native California blackberry.

The black raspberry (*Rubus occidentalis*) is native to New Brunswick and Quebec and also southward and westward. The stems are characteristically curved and root at the tips. They are cov-

ered over with hooked prickles. The fruit is purple-black and is edible. Various horticultural varieties of black raspberries have been derived from our wild native plant. The red raspberry (*Rubus idaeus*) is native in the northern United States and Canada, and across the continent. It is found also in Asia and Europe. This differs from the black raspberry not only in its red fruit, but also in its upright stems which are beset with stiff straight bristles. The sepals are velvety. This berry is delicious in the wild state and from it has been produced our cultivated red raspberry.

NINEBARK

PAGE 573

Physocarpus opulifolius

DESCRIPTION: Shrub, 3 to 10 feet high; leaves, roundish, somewhat 3-lobed, and heart-shaped; flowers, in white clusters.

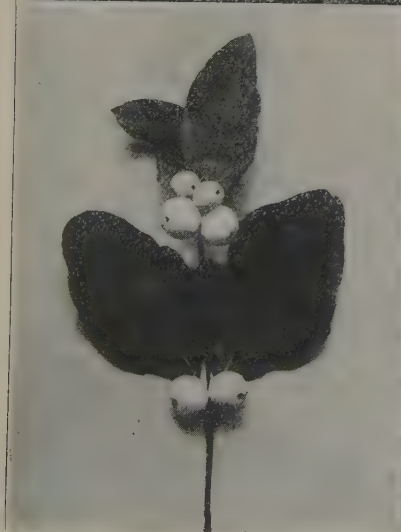
DISTRIBUTION: On river banks and in rocky places from Quebec to Florida and west to Manitoba and Kansas.

This shrub has long curved branches. The stems are light brown and the bark when old becomes loose and shredded, separating into many layers; hence the name ninebark. The leaves are dark green, somewhat like those of the maple in shape. The blossoms of the ninebark come in June and quite closely resemble those of its near relative, the spiraea. As in most members of this family, there are five rounded petals and many stamens. The fruit is very characteristic. The heavy clusters of purplish pods weigh down the shrub and are conspicuous. The ninebark is often cultivated for ornament.

HONEYSUCKLE FAMILY

Caprifoliaceae

The honeysuckle family is a small family of about three hundred species, consisting of shrubs, trees, vines, and perennial herbs with opposite leaves and a calyx tube adherent to the ovary. Besides the various honeysuckles and the snowberry, described here, and the coralberry, this family includes the elder (p. 576), various viburnums, or arrowwoods (see p. 578), the wolfberry, the wayfaring tree or hobblebush, the twinflower, and the horse gentian or feverwort.



*First three photographs, courtesy, Wild Flower Preservation Society
Left photographs by E. L. Crandall and P. C. Standley*

New Jersey Tea

Japanese Honeysuckle

Cultivated Snowberry

Staghorn Sumac

HONEYSUCKLE

PAGE 571

Lonicera

DESCRIPTION: Erect or climbing shrub with tube-shaped or funnel-shaped flowers of various colors.

DISTRIBUTION: Widely distributed, some species having escaped from cultivation.

The honeysuckle hides its nectar deep down in its long tube where only the humming bird and butterfly can reach it, although sometimes bees bite holes in the honeysuckle's tube and steal the nectar without rendering any service in return. The honeysuckles, especially the climbing ones, are very ornamental, and many of them are cultivated. One of the best-known species is the coral or trumpet honeysuckle (*Lonicera sempervirens*), which ranges in thickets from Maine to Nebraska and southward. It has bright red trumpet-shaped flowers, which are very attractive, though not fragrant.

The Japanese honeysuckle (*Lonicera japonica*) was introduced into cultivation in the United States from Asia. It has, however, run wild in many places from Connecticut to Florida and is one of the commonest wild vines of the southern states. The blossoms are white, pink, or yellow. The corolla has two lips which curl back from the stamens and pistil in characteristic fashion. The flower is very fragrant and much admired on this account. The berries are black. There are a number of wild honeysuckles common in the woods in the northern states and also there may be mentioned the bush honeysuckle (*Diervilla*), which has yellow flowers and is found on dry hillsides.

SNOWBERRY

PAGE 571

Symphoricarpos racemosus

DESCRIPTION: Low shrub with smooth slender branches, oval leaves, small pink flowers, round white berries in clusters.

DISTRIBUTION: In rocky places and on river banks from Nova Scotia to British Columbia and south to Kentucky and California.

The snowberry has clusters of small pink flowers in June and July, which are followed by very showy small white berries ranging in size from that of a pea to that of a small marble. These berries



Upper left photograph by E. L. Crandall
Upper right photograph by E. S. Shipp

Courtesy, Wild Flower Preservation Society
Courtesy, U. S. Forest Service

Rhododendron
Hazelnut
blossoms

Ninebark
fruit

Mountain Laurel
Hazelnut
fruit

last until November and are very conspicuous and ornamental. The snowberry is easily cultivated and is very popular with growers on account of its attractiveness. A very close relative of this species, the coralberry or Indian currant (*Symphoricarpos orbiculatus*), which has red currant-like berries, also beautiful in the autumn, is often planted with the snowberry for contrast.

HEATH FAMILY

(See Page 483)

RHODODENDRON

PAGE 573

Rhododendron

DESCRIPTION: Shrub or tree with long thick green leaves; showy flowers which vary in color from white or pink to purple.

DISTRIBUTION: In low woods and along streams from Nova Scotia along the mountains to Alabama. It is especially characteristic of the Alleghenies.

The name *Rhododendron* means "rose tree" and although it is not closely related to the rose, this handsome shrub rivals it in beauty. The smooth, rich evergreen leaves form a fitting background for the handsome flowers. The rhododendron is the state flower of West Virginia. *Rhododendron californicum*, the rosebay, or coast rhododendron, is the state flower of Washington.

MOUNTAIN LAUREL

PAGE 573

Kalmia latifolia

DESCRIPTION: Erect evergreen shrub with clusters of showy pink flowers.

DISTRIBUTION: In woods, preferably on rocky or sandy soil, from New Brunswick to Ontario and south to Florida and Louisiana.

The laurel is noted not only for its beauty but also for its remarkable adaptation for cross-fertilization. When the flower opens, the stigma appears erect in the center, but the anthers are turned downward, each of them being fastened into a little pocket. When the bee enters the flower for a sip of nectar, he releases a spring. The anthers fly upward and the insect is dusted with pollen, which he carries to the next flower.

The flowers of the laurel have a peculiar angular form. The size and color vary in different species. The mountain laurel, which is the state flower of Connecticut, is the largest. A related species, known as the sheep laurel, or lambkill, is a smaller bush with narrower leaves and small purplish blossoms. It grows in moist soil or on hillsides from Newfoundland to Hudson Bay and south to Georgia. Its name suggests the disastrous effect which the leaves of all the laurels have when eaten by sheep or cattle. Unless the animals are promptly treated they are likely to die from its poisonous effect. When the laurel was made the state flower of Connecticut, there was much opposition to it on the part of many, who disliked to think of a plant so poisonous to sheep as a state flower.

WOODLAND SHRUBS

WITCH-HAZEL FAMILY

Hamamelidaceae

This family includes the sweet gum of the southern states as well as the witch-hazel. Probably the most distinctive feature of the family is the woody seed capsule which contains a single bony seed in each of its two cells.

WITCH-HAZEL

PAGE 577

Hamamelis virginiana

DESCRIPTION: Tall shrub with straight-veined leaves and yellow flowers.

DISTRIBUTION: From Nova Scotia to Minnesota and south to Georgia and Arkansas, in dense woods.

The flowers of the witch-hazel are about the last to appear in the autumn. They remain and are beautiful after the leaves have fallen, giving the woods a characteristic and most delicious fragrance. The calyx is green without and yellow within, and there are four long stringy petals. After the flower has been fertilized and has faded, the calyx and the young pistils remain over winter. The ovary develops during the following year and the hard black bony seeds ripen in late summer or early autumn just before the flowers of the next season appear.

The seeds of the witch-hazel are shot for yards through the air by the sudden bursting of the capsule. The shooting of the seeds is due to the contraction of the inner lining of the seed pod, which in opening frees the seeds by pressure and causes them to fly off.

The very familiar extract of witch-hazel used in medicine and for other purposes is made by distilling the leaves and the bark in alcohol. In former times the witch-hazel was thought to possess magic properties, the branches being used to detect the presence of precious metals or underground waters.

HONEYSUCKLE FAMILY

(See Page 570)

ELDER

PAGE 577

Sambucus canadensis

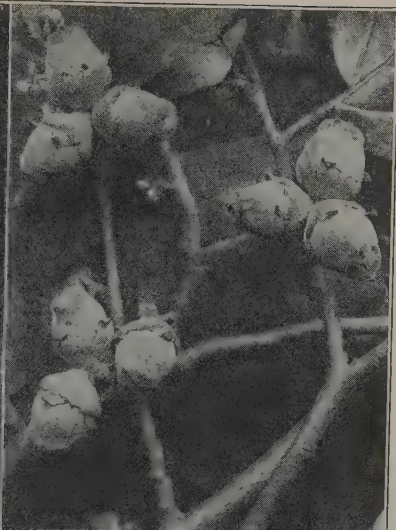
DESCRIPTION: Shrub with compound leaves divided into toothed leaflets; large flat clusters of white blossoms; and black-purple or red fruit.

DISTRIBUTION: Widely distributed throughout the temperate parts of North America.

The elder, with its abundance of fragrant blossoms and of edible fruit, is as useful as well as a decorative shrub. The clusters of tiny white flowers appear in early summer and are extremely delicate and lacelike. They have a very sweet odor. Later on there follows a profusion of berries. The blossoms are distilled with water to make elder-flower water, used in confections and in medicine. Both the fruit and flower are made into wine and are also used for various medicinal purposes. Sauce and jam are made from the ripe berries. The large pithy shoots of the elder are excellent material for popguns and whistles.

The scientific name is believed to be derived from *sambuke*, an ancient musical instrument made from the hollow stems. The stems are also used in maple-sugar camps to conduct the sap from the tapped tree to the sugar pail or trough.

In the northern states there occurs another species of the elderberry (*Sambucus racemosa*). It has very showy red berries in early summer. The blossoms and berries in this species are in panicles instead of in a flat-topped inflorescence.



Witch-Hazel

Witch-Hazel
fruit

Elder

Elder
fruit

ARROWWOOD

PLATE 6

Viburnum

DESCRIPTION: Shrub with simple leaves and white to pink flowers in flat compound clusters.

DISTRIBUTION: Widely distributed throughout temperate North America.

The arrowwoods or viburnums are a group of very attractive shrubs with tough flexible branchlets and dense clusters of flowers. The five-petaled corollas have very short flower tubes so that insects with short honey-probes can reach the nectar. In the autumn there are clusters of highly colored berries ranging from blue to black or red, depending upon the species.

The plant most commonly referred to as arrowwood is *Viburnum dentatum*. This is a small upright shrub with toothed leaves. Another variety is the maple-leaved viburnum (*Viburnum acerifolium*). This is a handsome low shrub with flowers and berries. A very beautiful species is *Viburnum opulus* or high-bush cranberry. It has an acid reddish fruit which may be used as a substitute for cranberries. This species is well known in cultivation, as is the snowball, which has been derived by breeding from the native form. The black haw (*Viburnum lentago*) is the largest of the viburnums and may be either a tall shrub or a small tree. This species has black edible fruit and grows in rich woods.

ROSE FAMILY

(See Page 504)

HAWTHORN

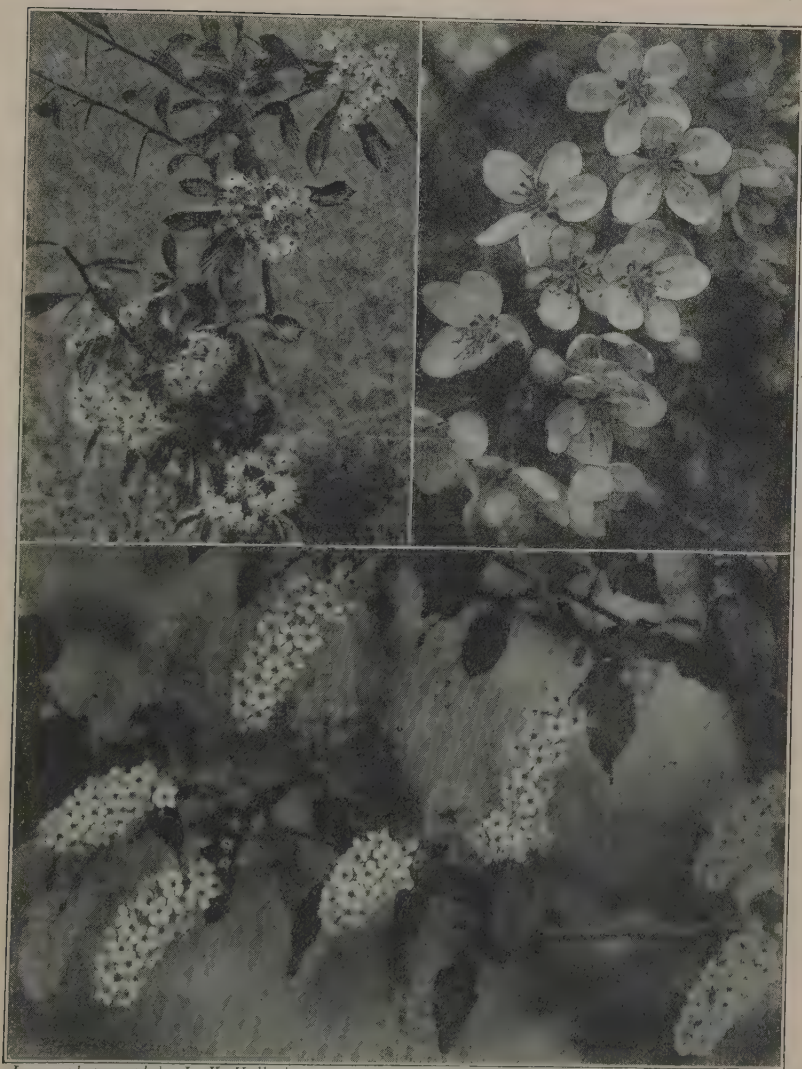
PAGE 579

Crataegus

DESCRIPTION: Thorny shrubs or small trees with simple leaves; white flowers and small, apple-like fruits.

DISTRIBUTION: Widely distributed in the United States and in Canada.

There are many species of hawthorn which are so closely related to one another that it is difficult for an amateur to distinguish them. The hawthorn is often known as red haw or thorn apple. It is very attractive and is often cultivated on account of its beauty. The flower appears in May and June and the fruit ripens in Sep-



Lower photograph by L. V. Hallock

Courtesy, Wild Flower Preservation Society

Hawthorn

Wild Crab Apple Blossoms

Cherry Shrub

tember. Although the fruit resembles the apple in general structure, it is very small. In some species the fruit is large enough and contains enough flesh to be really edible and it is very delicious when made up into jellies and preserves. The wood of the hawthorn is very hard and tough. It takes a fine polish but is apt to warp.

CRAB APPLE

PAGE 579

Pyrus ioensis

DESCRIPTION: Small tree with leaves larger than in most apple trees and large, very fragrant pink flowers.

DISTRIBUTION: Western New York to western Ontario and south along the Appalachians to North Carolina.

In May, when it is laden with large fragrant pink flowers, the American crab is a magnificent sight and is one of the most attractive trees in any landscape. It is visited by swarms of bees which gather its honey and spread its pollen. The fruit is hard and yellow when ripe and is about an inch in diameter. It is not edible raw but is delicious in preserves and jellies.

CHOCHECHERRY

PAGE 579

Prunus virginiana

DESCRIPTION: Shrubs or small trees with simple leaves; white flowers in racemes; reddish-black, juicy, one-seeded fruit.

DISTRIBUTION: From Nova Scotia west to South Dakota, south to Florida and Texas; in woods and thickets.

The chokecherry, either in flowering or in fruiting time, is among the most beautiful of shrubs. The odor and taste are very characteristic, and the wood secretes a gum in places where it has been wounded. The leaves are broad and are dull green in color. The dark red fruits, which become almost black as they mature, are very puckery to the taste, whence the common name, chokecherry.

Closely related to the chokecherry is the wild black cherry (*Prunus serotina*), whose distribution is somewhat similar. This tree often grows to great size, and may have a height of one hundred feet. The leaves are rather long, and are pointed and shiny. The black fruit has a pleasant, though somewhat bitter, flavor. An easy means of identifying the tree in winter is by its peculiar con-

cave bark plates. This is one of the most valuable of our lumber trees, for cherry wood has a color that is very popular and is capable of taking a fine finish.

Among other wild cherries is the pin cherry (*Prunus pennsylvanica*), which has attractive small red fruits in umbel-like clusters, somewhat like a miniature of the cultivated cherry. This species is especially common in the northern states and in Canada. Very frequently the pin cherry appears after fires.

DOGWOOD FAMILY

Cornaceae

The dogwood family is small, consisting of about eighty-five species of shrubs and trees, and is widely distributed throughout the Northern Hemisphere. The North American members include the tupelo, the sour gum, and a number of species of dogwood.

FLOWERING DOGWOOD

PLATE 6

Cornus florida

DESCRIPTION: A tall shrub or small tree with small white, greenish-white, or yellow flowers; flowers in close heads surrounded by petal-like bracts which give the effect of a large flower.

DISTRIBUTION: Usually under the shade of trees in rich soil from Maine to Michigan and south to Florida and Texas.

The flowering dogwood, with its white showy flower heads, is one of the most beautiful of all the woodland shrubs and small trees. The true flower, however, is very inconspicuous, the attractiveness of the plant being due entirely to the conspicuous bracts which are white to pink in color. They blossom from April to June, varying with the latitude. The leaves are small and opposite. They have a rich red color in the autumn and with the bunches of bright red berries produce a very colorful effect.

The flowering dogwood, which is the best-known member of the dogwood family, is the state flower of Virginia. Among other species of dogwood that may be mentioned is the red-osier dogwood

(*Cornus stolonifera*), which is well known and immediately recognized by its beautiful red-purple twigs that gladden the winter landscape. The silky dogwood (*Cornus amomum*), which has blue berries with a silvery sheen, was called kinnikinnick by the Indians, a name which meant that the leaves are good for smoking. One of the most showy of the dogwoods is the dwarf dogwood (*Cornus canadensis*). This is similar to the flowering dogwood in its showy bracts, but the plant is a small herb instead of a shrub. It is found in damp cold woods in Canada and in the northern tier of states in the United States.

The scientific name of the dogwood comes from *cornu*, the Latin word for horn, and was given to these shrubs because of the hardness of their wood. This makes it a good wood for turning and it is also used for charcoal. The wood is especially suitable for the manufacture of shuttles, bobbins, golf-club heads, and many novelties. There is, in fact, such a demand for the wood, and the supply is so limited, that ways have been especially devised to keep waste at a minimum.

SAXIFRAGE FAMILY

Saxifragaceae

This family, consisting of a variety of shrubs and herbs, is rather closely related to the rose family, differing from it largely in the absence of *stipules* (leafy appendages at the base of the leaf), in having a definite number of stamens, and in having fewer carpels than sepals. The saxifrage family includes both herbs and shrubs of varying aspects, among which may be mentioned the saxifrage, which gives the name to the family, the mock orange or syringa, the hydrangea, the gooseberry, and the currant.

WILD BLACK CURRANT

Ribes floridum

DESCRIPTION: Erect shrub with 3- to 5-lobed leaves and bell-shaped greenish-white or yellow flowers.

DISTRIBUTION: In woods from Nova Scotia to Manitoba, Virginia, and Nebraska; also in New Mexico.

The wild black currant is a graceful shrub with erect, spreading branches and luxuriant foliage. The leaves are bright green above and paler beneath and are somewhat heart-shaped. The flowers appear in May and hang in long, loose, drooping racemes. The smooth black berry is crowned with the remnant of a calyx. While edible this fruit is not very tasty. Other members of this same genus which are especially characteristic of woodlands are described below.

GOOSEBERRY

PLATE 6

Ribes

DESCRIPTION: The gooseberry is very closely related to the currant, differing from it chiefly in having prickly instead of smooth stems. The fruits sometimes are prickly also. The flowers are usually in clusters of from 1 to 5, instead of being in racemes as in the currants.

DISTRIBUTION: From Newfoundland to Manitoba and south to North Carolina and Missouri.

The most common native gooseberries are the prickly gooseberry (*Ribes cynosbati*) and the smooth gooseberry (*Ribes oxycanthoides*). The prickly gooseberry has prickles not only on the stems, but also on the fruit. The smooth gooseberry, as its name indicates, has quite smooth fruit, although the stem, of course, is prickly. Both of these gooseberries grow commonly in rich woods and are edible. The smooth gooseberry is particularly delicious raw or cooked. The prickly gooseberry is edible also, but the prickles somewhat interfere with its palatability.

SWAMP SHRUBS

LAUREL FAMILY

Lauraceae

The laurel family, strange as it may seem, does not include the so-called laurels of the Allegheny Mountains, which belong to the rhododendron group of the heath family (see p. 574). It does, however, include the bay or sweet laurel of Italy and Greece and the California laurel.

The most familiar members of this family in the northern states are sassafras and spicebush and in the southern states, swamp bay. All the members of this family are aromatic and beautiful. Many of them are used in medicine. The laurel of Greece and Italy is often mentioned in the literature of Greek and Roman times. It was from the shining evergreen leaves of this plant that the famous wreaths of victory were made. The northern members of this family are deciduous rather than evergreen.

SPICEBUSH

PAGE 587

Benzoin aestivale

DESCRIPTION: Shrub with small yellow flowers in umbel-like clusters.

DISTRIBUTION: Swampy woods from southern Maine to Ontario, Kansas, and southward.

The fragrant honey-yellow flowers of the spicebush appear before the leaves, several clusters being grouped together against the bare branches. In the fall, there are rather large single-seeded red berries which are quite showy among the leaves. The bark is very aromatic and has a pleasant peppery taste. It is sometimes called Benjamin bush and is also known as wild allspice and fever bush.

During the Revolutionary War when allspice was kept out of American markets, housewives used the powdered berries of the spicebush as a substitute. The leaves have also been used as a substitute for tea. The scientific name of the plant is explained by the odor of the spicebush, which resembles that of benzoin, an oriental gum.

WILLOW FAMILY

Salicaceae

The willow family consists of trees and shrubs with light wood, bitter bark, and alternate leaves. The twigs are sometimes brittle, but more often are flexible or willowy. The male and female flowers are found on separate plants and so the plant is called dioecious. Two large genera make up this family, the poplars and the willows. With the poplars may

be included the aspen and the cottonwoods. The poplars are trees, whereas most of the willows are shrubs, although several species grow to large trees.

GLAUCOUS OR PUSSY WILLOW

PAGE 589

Salix discolor

DESCRIPTION: Large shrub or small tree with rather bright green leaves and furry catkins appearing before the leaves.

DISTRIBUTION: In swamps from Nova Scotia to Saskatchewan, Delaware, and Missouri.

The pussy willow may be defined as a shrub willow with flowers appearing before the leaves. Most of the tall willows and some of the smaller willows blossom after the leaves appear and do not have the pussy-like effect of the so-called pussy willow. The pussy willow is one of the first to respond to the call of spring. The furry catkins appear early in March, long before the leaves have developed. The pussy willows are very well pollinated by insects, especially bees which visit the fragrant flowers in great numbers and spread the pollen readily over the stigma of the next plant they visit.

HEATH FAMILY

(See Page 483)

BLUEBERRY

PAGE 587

Vaccinium corymbosum

DESCRIPTION: Shrub with white or pinkish flowers and blue berries.

DISTRIBUTION: In swamps and bogs from Maine to Minnesota and south to Virginia and Louisiana.

This is the tallest and perhaps the most important commercially of all the blueberries. This species grows only in swamps and bogs, while the other blueberries are rather more likely to grow in sterile soil, often of sandy nature. The cranberry, which is familiar to all because of its beautiful red berries, is closely related to the blueberry and also grows in bogs.

This species of blueberry is sometimes called high bush or swamp blueberry and may reach a height of from ten to fifteen feet. It is

covered with enormous numbers of berries which are all of good size and extremely attractive in appearance. The fruit is usually covered with a white waxy bloom. The stems of this and other blueberries are mostly green and warty.

For the most part, the commercial source of blueberries has been from wild plants. Recently, however, it has been found that by special treatment it is easy to cultivate the high bush or swamp blueberry. Horticulturally improved varieties with berries approximately the size of cherries are now on the markets.

BAYBERRY FAMILY

Myricaceae

This is a small but widely distributed family of aromatic resinous trees and shrubs. In addition to the bayberry, described below, the family also includes the sweet gale, sweet fern, and wax myrtle, the last-named also being known as candleberry, waxberry, or tallow shrub, because the wax has been much used in making candles.

The *Myricaceae* are a family of monoecious or dioecious woody plants with each kind of flower in short scaly catkins. They are rather closely related to the birch family, differing from it in having a single fertile flower hanging under each scale instead of two or three together.

BAYBERRY

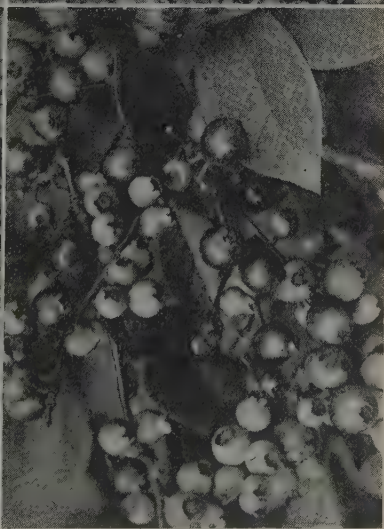
PAGE 587

Myrica carolinensis

DESCRIPTION: Shrub with oblong leaves; flowers, in short, scaly catkins; blue berries.

DISTRIBUTION: Sandy or sterile soil, chiefly near the coast, from Prince Edward Island to Florida and Louisiana; also found along Lake Erie.

The bayberry is sometimes called waxberry and tallow shrub, although these names are perhaps more familiarly applied to its close relative, the wax myrtle. In colonial times, and even more recently when animal fats were scarce, it was found that the wax of this species and also that of the wax myrtle could be used



Spicebush
fruit

Bayberry
flower

Bayberry
fruit

High Bush Blueberry
fruit

instead of tallow in making candles. Bayberry candles are more brittle and less greasy than those made from tallow. They have an attractive gray-green color and when the flame is extinguished, there is a pungent odor.

MADDER FAMILY

Rubiaceae

The madder family is a very large one, consisting of more than six thousand species of plants. The majority of these belong to the tropics. This family includes a great many useful plants, such as coffee, cinchona (the source of quinine), ipecac, and the madders from which dyes are obtained. A number of herbs and shrubs belonging to this family are found in North America, such as the houstonia, the bluets, the partridge berry, various species of bedstraw, and the buttonbush which is described below.

BUTTONBUSH

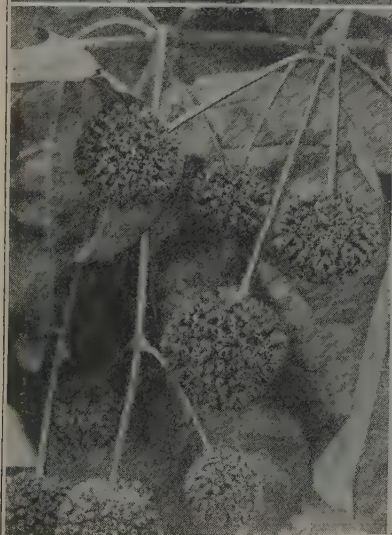
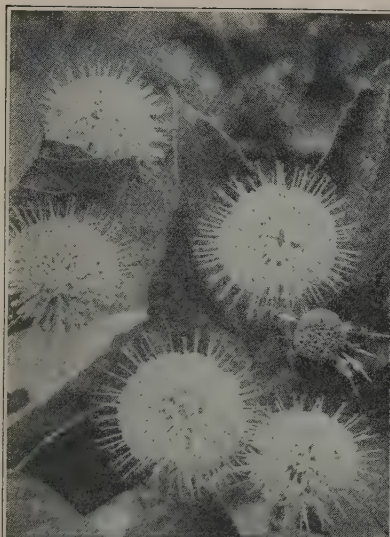
PAGE 589

Cephalanthus

DESCRIPTION: Shrubs which may be rather tall, with white flowers and dense spherical heads.

DISTRIBUTION: In swamps from New Brunswick to Ontario, Florida, and California.

The flower cluster of the buttonbush is very unusual in form, being practically a perfect sphere made up of hundreds of tiny cream-white flowers crowded upon a central axis. The general appearance of the flower is rather like that of the sycamore, which for a similar reason is often known as buttonball. From each side of the floral sphere project threadlike styles. The flowers are very fragrant and are so full of honey that the plant is sometimes called honeyballs. The nectar lies very deep and can be reached only by long-tongued insects. The buttonbush is a stout erect shrub, growing from three to twelve feet in height, and the branching is extremely irregular and often elbow-like, so that it is impossible to find a straight branch of any length. On this account it is often called elbow bush, especially in the South. The leaves are large



Lower right photograph by E. R. Mosher

Courtesy, U. S. Forest Service

Buttonbush
flower

Buttonbush
shrub

Buttonbush
fruit

Pussy Willow
flower

and rather coarse, appearing opposite or in threes. The leaves are bright green and shiny. The fruit is a ball made up of many small capsules crowded together, each capsule containing one or two seeds.

DECIDUOUS TREES

MAPLE FAMILY

Aceraceae

The maple family is one of the most easily recognized of all tree families. Its fruit is the well-known key which contains the seed at one end and has a long thin paper-like wing at the other. The keys are joined together in pairs.

The trees belonging to this family have sweet sap. The branches are slender and the leaves and branches are opposite. In most cases the leaves are simple, but in the box elder the leaf is compound.

SUGAR MAPLE

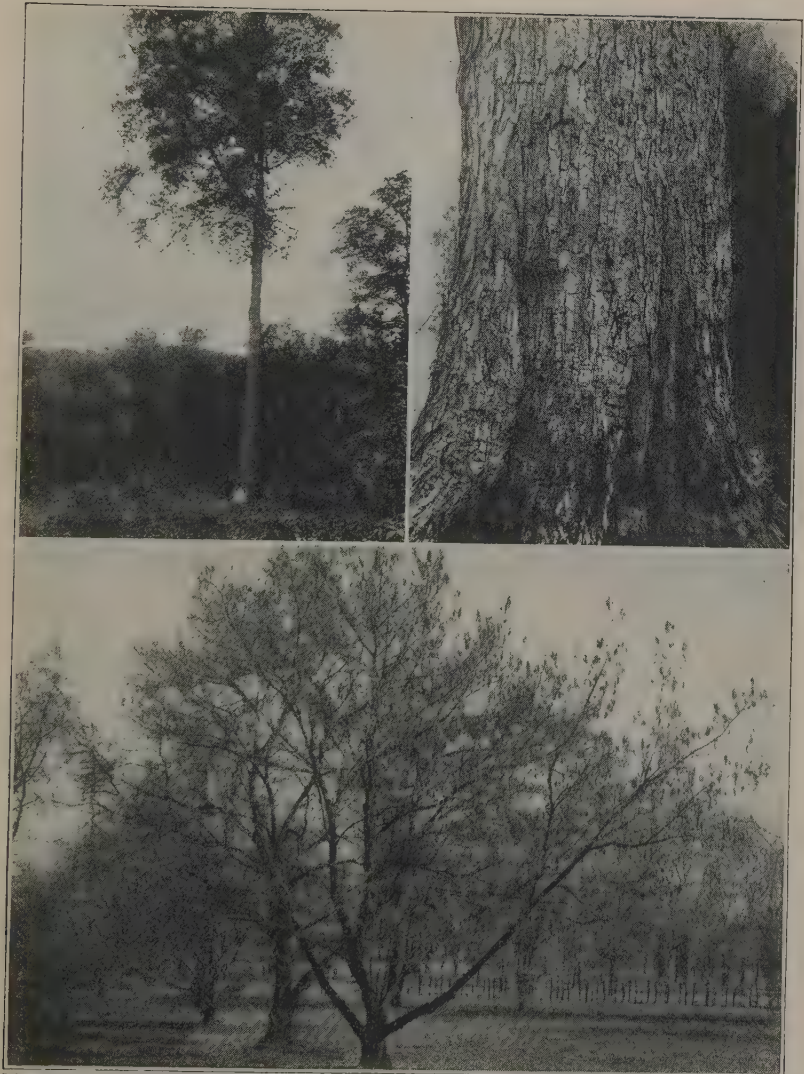
PAGE 591

Acer saccharum

DESCRIPTION: Large tree with broad symmetrical crown; leaves, 3- to 5-lobed; flowers, greenish-white, drooping on slender, hairy pedicles, appearing after the leaves.

DISTRIBUTION: Rich woods, Newfoundland to western Ontario and south along the Appalachian Mountains to Georgia and eastern Louisiana.

The sugar maple is one of the most useful as well as one of the most beautiful of trees. It rises to a height of seventy to one hundred feet and its foliage is dense, making it a greatly admired shade tree. In the autumn the red, yellow, and orange tints are among the most brilliant colors in the woods. It is chiefly from this tree that we get our maple sugar. It is also the most important of the maples from the timber point of view, for its wood is hard, strong, and close-grained. Some particularly beautiful lumber is obtained from the so-called curly or bird's-eye maple which is a special form of growth of the sugar maple. The timber of the sugar maple is used for furniture, shipbuilding, and interior finishings. The ashes, rich in potash, are valuable as a fertilizer.



Photographs by Varela, Lindsey, and Sudworth

Courtesy, U. S. Forest Service

Sugar Maple

Trunk of Sugar Maple

Box Elder with full crop of seed

BOX ELDER

PAGE 591

Acer negundo

DESCRIPTION: Tree with opposite compound leaves with 3 to 5 leaflets; flowers, small, drooping, the male and female flowers on separate trees (dioecious).

DISTRIBUTION: Along streams from Maine to Manitoba and south to Florida, Texas, and Mexico. A closely related species with thicker leaves is found in the Rocky Mountains.

The box elder, sometimes called the ash-leaved maple, is the only native maple with compound leaves. One would hardly take it for a maple were it not for the seeds, which are keylike as in other members of the family. This key remains on the tree after the leaves have fallen. The wood is soft and not very valuable, although useful for woodware, pulp, and cheap furniture.

The box elder grows quickly and on this account is often planted as a shade tree, but the branches are broken easily and with its ragged clusters of seeds in the winter, the tree often has a disheveled appearance.

BEECH FAMILY

Fagaceae

The most valuable and important of the hardwood trees from the commercial side are members of this family which includes the beech, the chestnut, and the oak. All of these trees have alternate leaves, and have male and female flowers on the same tree. The male flowers are in long, slender catkins, whereas the female flowers are small and scaly.

BEECH

PAGE 593

Fagus ferruginea

DESCRIPTION: Tree with close, smooth, light ash-gray bark and alternate simple straight-veined leaves.

DISTRIBUTION: Rich woods from Nova Scotia to Minnesota and south to Florida and Texas.

The beech has been almost as much praised as its cousin, the oak. It is one of the most beautiful and stately of trees and is easily dis-



Beech Tree

Courtesy, U. S. Forest Service

tinguished from others by its bark, which is close and light gray and is marked with blotches of a paler color. It is a fine, symmetrical tree with horizontal or slightly drooping branches, thickly set with slender, flexible twigs. Its maximum height is one hundred twenty feet, and the trunk diameter reaches three or four feet.

The pointed leaf buds are very well protected with dark brown scales. When the leaf first unfolds, it is covered with soft silky hairs which soon disappear. The full-grown leaf is smooth and strongly veined. It clings to the tree most of the winter.

The flowers are yellow. Both the male and female flowers occur on the same tree, though in separate clusters. The fruit is a prickly burr within which are two three-cornered nuts, chestnut-brown in color, thin-shelled, and delicious in flavor.

The Latin name, which comes from a Greek word meaning "to eat," was given to the beech because of its edible nuts.

The wood of the beech is hard and close-grained and is used in making chairs, shoe lasts, handles for tools, and for fuel. It makes good bowls because it absorbs very little water. "Beechen bowls" are referred to by the ancient writers.

WHITE OAK

PAGE 597

Quercus alba

DESCRIPTION: Tree with simple 5-ranked leaves which are round-lobed; fruit, an acorn in a scaly cup.

DISTRIBUTION: Throughout the temperate regions of eastern North America.

Since the earliest times the oak seems to have been considered a symbol of strength and endurance. Nearly three hundred species of oak are known. The white oak, a specimen of North American oaks, sometimes grows to a height of more than one hundred feet and has widely spreading branches. The trunk may grow to a diameter of six to eight feet. The spreading branches make the tree very beautiful and desirable as a shade tree. The leaves have a leathery texture and are strongly veined. Late in the autumn they turn a deep rich red.

The white oak is the most valuable, for its timber, of the hard woods, for its wood is hard, close-grained, and durable. It is used in shipbuilding, for making agricultural implements and furniture, and for the interior finish of houses, as well as for many other purposes. Other species of oak, such as the red oak, bur oak, and black oak, are less valuable from the commercial viewpoint, although many of them are much used. The white oak may be immediately distinguished from the red oak and its near relatives through the fact that it has round-lobed leaves while the black and red oaks have leaves with sharp tips.

WALNUT FAMILY

Juglandaceae

The hickories and walnuts are grouped together in this small but very important family, which includes some of the most valuable timber- and nut-producing trees. Members of this family have compound leaves, with leaflets arranged on both sides of a common stem. They also have staminate and pistillate flowers on the same tree (monoecious). The fruits of all the members of the walnut family are somewhat similar in that they have a husk enclosing a thick- or thin-shelled nut.

SHAGBARK OR SHELLBARK HICKORY

PAGE 597

Carya ovata

DESCRIPTION: Tree, 60 to 90 feet high with spreading branches; bark, pale brown, shredded and very shaggy; leaves with 5 to 7 leaflets.

DISTRIBUTION: Rich uplands from the St. Lawrence Valley west to Minnesota and south along the Appalachians to Alabama and Mississippi.

In spite of the ragged and shaggy appearance of the bark, the shagbark hickory is a fine-looking tree with a tall straight trunk. The flowers are green and inconspicuous. The nut is the common hickory nut of commerce and is contained in a four-parted husk which drops away when the nut is ripe.

The hickory is a slow-growing tree. Its wood is very hard and close-grained and is very valuable for the manufacture of implements where strength is essential.

The pecan (*Carya illinoensis*) is another species of hickory highly prized for its delicious nuts. It has a more southerly range but gets as far north as central United States and grows especially in low grounds near rivers.

BLACK WALNUT

PAGE 597

Juglans nigra

DESCRIPTION: Tree with deeply furrowed bark; leaves with numerous leaflets.

DISTRIBUTION: Rich bottom lands and woods from western Massachusetts to Minnesota and south to Florida and Texas.

The black walnut can be identified by its crown of yellow-green leaves, its round nuts in husks that hang like small green oranges, and by the pungent odor. The wood is very heavy, hard, and strong, and takes a high polish. It is one of the best woods for furniture and is also in great demand for gunstocks. On account of the great use of lumber trees for gunstocks in war time, the trees, once very plentiful, have become correspondingly scarce.

The flowers appear in May when the leaves are half grown. The male flowers come first in smooth, slender catkins and the female flowers appear a little later, borne in a two- to five-flowered spike. The nuts do not drop out of their husks as do the hickories. These

husks contain a juice that leaves a permanent brown stain. The shell of the nut is deeply ridged, thick, and black. The nut is rich in oil and of fine flavor, but the hard shell and the fact that it does not keep very well because of the great amount of oil make it of less commercial value than its close relative, the English walnut.

The English walnut (*Juglans regia*) is a native of southern Europe and Asia and has been cultivated more especially in California. It is one of the most prized of all edible nuts.

The butternut or white walnut (*Juglans cinerea*) is a native American tree that is closely related to the black walnut. The bark is lighter in color and the wood a lighter brown. The nut differs in its oblong shape and in its being narrowed to a point at the end.

OLIVE FAMILY

Oleaceae

The olive family, at first sight, seems to be a somewhat loose association of different-looking plants, for it includes the olive, the lilac, and the ash. The most familiar plant of this family, native in the northern states, is the ash, with its several species. This family includes such cultivated plants as the forsythias and privets, as well as the jasmines. In this family the leaves and branches are opposite.

WHITE ASH

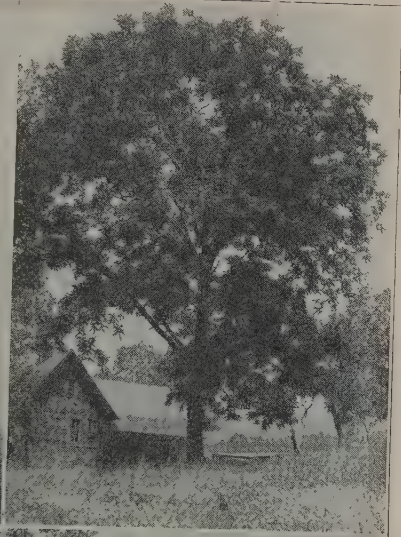
PAGE 599

Fraxinus americana

DESCRIPTION: Large tree with ascending limbs and deeply furrowed bark which is almost black; leaves and branches, opposite, leaves usually having from 5 to 9 leaflets; flowers, green to purple, without petals; male and female flowers on separate trees.

DISTRIBUTION: Rich moist woods and along river banks from Nevada to Ontario, Florida, and Texas.

The white ash is large and valuable for timber and is also much used for shade. It has a large trunk and sometimes reaches a height of twenty feet. The name ash refers to the ashy color of the branches. The white ash is so called because of the whitish under-surface of the leaves and particularly because of the beautiful white



Upper left photograph by A. T. Boisen; upper right, by E. S. Shipp Courtesy, U. S. Forest Service

Shagbark Hickory

Black Walnut

White Oak

wood. The curious flower of the ash comes out in spring before the leaves appear. The pollen is produced in great abundance and is carried by the wind. The wood of the ash is very valuable for the manufacture of tool handles, oars, and agricultural implements. The fruit of the ash consists of a single key which thus differs from the maple.

Among other species of ash that are found commonly in the woods are the black ash, which grows in swampy ground; the red ash, which resembles the white ash very closely except in the lighter color of its branches; and the blue ash, easily recognized by its four-angled branches.

NETTLE FAMILY

Urticaceae

This is a large family especially characteristic of the tropics, and contains herbs, shrubs, and trees, many of which look quite unlike one another. The family includes the elm, mulberry, osage orange, hemp, hop, and the nettles.

MULBERRY

PAGE 599

Morus rubra

DESCRIPTION: Tree with slender branches and alternate, entire or 3-lobed leaves; flowers, small, in catkins; fruit, oblong, juicy, and blackberry-like.

DISTRIBUTION: In rich soil from Vermont to South Dakota, and south to Florida and Texas.

The mulberry is a decorative tree and produces an abundance of sweet juicy fruit, which like the blackberry is made up of a great number of drupes. This fruit is of very little value in the market because it is soft and perishable, but it is good when eaten fresh from the tree. Mulberries are very much liked by wild birds as well as by poultry and hogs.

The mulberry wood is light brown and very durable, and is used for fence posts, bolts, etc. The Indians used to make rope and coarse cloth from the fiber of the bark.

The leaves of the mulberry are dark, showing very curious variations in form. The white mulberry (*Morus alba*), so called from its white fruit, is a native of Asia, but has been much cultivated



*Upper and lower photographs, courtesy, U. S. Forest Service
Upper left photograph by H. J. Tompkins; lower, by E. A. Tooley*

White Ash

Mulberry
fruit
White Elm

Mulberry

in the United States and has become thoroughly naturalized in certain parts. It was originally introduced into the United States largely because its leaves furnish the food for silkworms. When the silk industry was found unprofitable in the United States, the cultivation of the mulberry ceased. Still it remains on and even spreads spontaneously.

WHITE ELM

PAGE 599

Ulmus americana

DESCRIPTION: Tree with scaly, ridged bark arranged more or less in a diamond-shaped pattern; leaves with strong, straight veins.

DISTRIBUTION: In moist soil along streams from Newfoundland to Manitoba and south to Florida and Texas.

No tree surpasses the elm in stately grace. It is easily recognized by its characteristic form, which may be compared to a flaring vase.

The flowers come out very early in the spring, sometimes before the leaves appear, but they are so small and inconspicuous that they may escape notice. They are in little fringelike clusters. The sides of the leaf are unequal, there being a larger bulge on one side than on the other. The fruit is a small single-seeded key, or samara, somewhat resembling that of the maple except that the wing extends all around instead of only on one side.

The elm reaches a height of one hundred twenty feet. The wood is heavy, hard, and difficult to split. It is used for the hubs of wheels, for saddle-trees, in flooring and cooperage, and in boat- and shipbuilding.

Closely related to the white elm is the slippery elm (*Ulmus fulva*), which takes its name from the mucilaginous and fragrant inner bark which is used in the treatment of throat and lung diseases. The wood of the slippery elm is used for fence posts and for making agricultural implements.

PLANE-TREE FAMILY

Platanaceae

The plane-tree family consists of a single genus, *Platanus*. All of the trees belonging to this genus have watery juice and alternate palmately lobed leaves. The branches are zigzag and the bark peels off in thin plates.

SYCAMORE

PAGE 603

Platanus occidentalis

DESCRIPTION: Large tree with broad palmately lobed leaves, small green flowers in dense heads, and ball-shaped fruits.

DISTRIBUTION: Along streams from Maine to Minnesota and south to Florida and Texas.

The sycamore or buttonball tree perhaps might better be called plane tree since the term "sycamore" was originally used for a species of fig tree native in Egypt and should perhaps be still applied to that species. The sycamore is the most massive tree in eastern North America and often grows to a tremendous size. It is a very rapid-growing tree, springing up from seed in a few years to a tree of large proportions.

The name plane and the scientific name *Platanus* mean "broad" and refer to the broad leaves. The flower appears about the time of the leaves and the tiny green blossoms are massed together in small round heads on long stems. The male and female flowers are in separate heads but often on the same branch. The fruit consists of round balls made up of many nutlets grown together. The surface is rough with the pin-head surface of the nutlets. These balls remain on the branches throughout the winter, after which they break up, and the seeds are scattered by the wind and water.

The wood of the sycamore is used for butchers' blocks, ox-yokes, and for other purposes.

WILLOW FAMILY

(See Page 584)

WHITE WILLOW

PAGE 603

Salix alba

DESCRIPTION: Tree with light dull brown bark; leaves, long, very pale beneath.

DISTRIBUTION: Native of Europe, widely distributed in cultivation; generally found in moist soil, along streams.

The white willow is a graceful tree with its narrow pointed leaves, which are pale green on the upper side and almost white

beneath. This species grows to a large size and has a great spread. Like most willows, it prefers moist ground and does splendidly along streams and on the margins of swamps. While willows depend largely on seeds for propagation, not infrequently branches drop off which take root and spread the species in that way.

The wood of the willow is soft and flexible and it is not much used in lumber except when better lumber is not available. Ever since ancient times willows have been much used in basketry and willow ware. In some places the willow trees are grown for this special purpose. The frequent cutting of the branches, known as pollarding, is a practice carried on so as to stimulate the growth of new branches, which are much more suitable for basketry.

The black willow (*Salix nigra*) is a native species and is common along streams throughout most of the United States. The wood is used for packing cases and for other purposes where strength is not important. The weeping willow (*Salix babylonica*) has drooping branches and is much cultivated in cemeteries and elsewhere. This species, perhaps largely because of its drooping branches, has long been considered the emblem of woe and despair.

COTTONWOOD OR POPLAR

PAGE 603

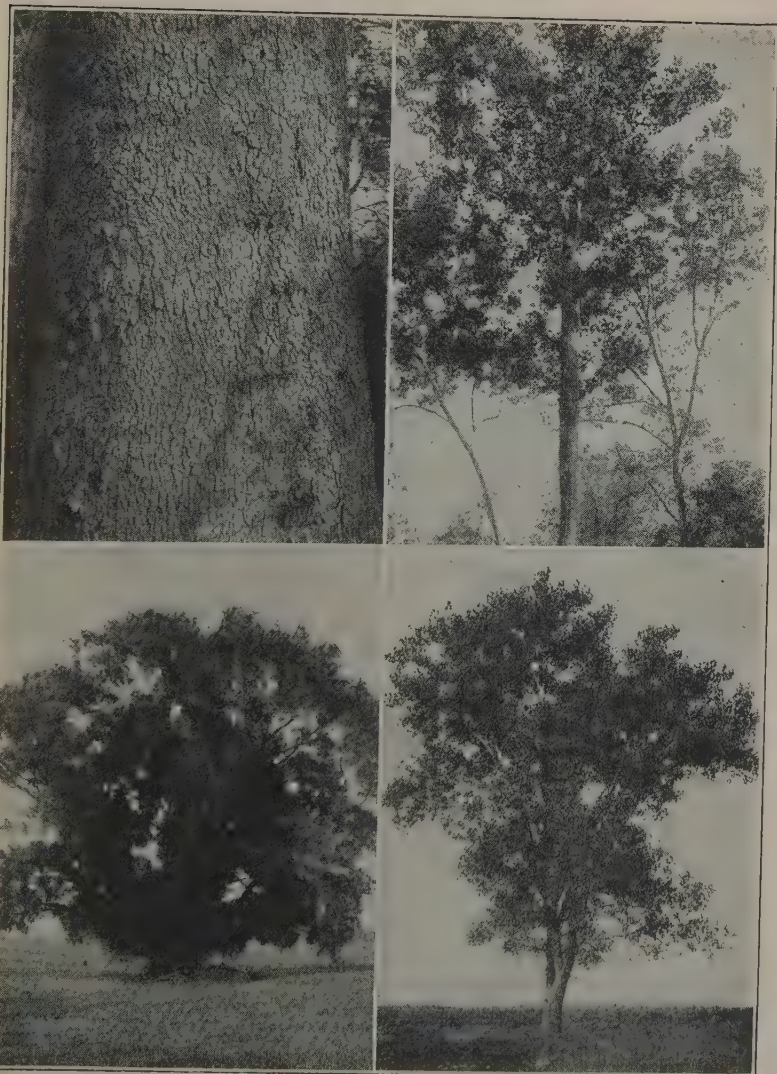
Populus deltoides

DESCRIPTION: Large tree with somewhat heart-shaped leaves, usually on long stems; flowers, in drooping catkins; seeds provided with cottony hairs.

DISTRIBUTION: Moist soil, especially along streams from Quebec to Manitoba and south to Florida and Texas.

The cottonwood is a rapidly growing tree and attains gigantic size. The buds are scaly and are covered with a sticky resin which is gathered by bees and used for sealing the crevices in their hives. The flowers appear before the leaves in long drooping handsome catkins, the male and female flowers being on separate trees. The male flowers in particular are very beautiful and showy. The shiny green leaves are suspended on long slender stalks and blow readily in the breezes. The trembling of the cottonwood and the aspen is due to the lateral compression of their long stems, which makes the leaves quiver at the slightest motion of the air. This is particularly noticeable in the aspen tree (*Populus tremuloides*).

The fruit of the cottonwood is a capsule which bursts when ripe



Photographs by Lindsey, Ashe, Lazenby, and Mason

Courtesy, U. S. Forest Service

Trunk of Sycamore

Sycamore

White Willow

Cottonwood

and discloses a light brown seed which is provided with a tuft of soft white hairs.

The cottonwood is so named because of the mass of "cotton" attached to the seeds. As a general rule, male trees are preferred in cultivation because most people dislike the cotton which is abundant at the time the seeds mature. The cottonwood is the largest of the poplars and is the most prevalent of all the trees along the river banks of central United States. It is not uncommon to find trees one hundred feet high with a trunk six to eight feet in diameter. It is sometimes called the necklace poplar because its fruits look like strings of beads.

The wood is soft, and because of its tendency to warp and because it is difficult to season, it is not very valuable for lumber. It is used, however, for paper pulp and for packing cases.

The balsam poplar (*Populus balsamifera*) is a closely related species rather more characteristic than the cottonwood of the northern states. The Lombardy poplar (*Populus nigra italica*) is a native of southern Europe and much cultivated in the United States because of its straight cylindrical form. These are sometimes grown in the West to serve as windbreaks.

BIRCH FAMILY

(See Page 566)

WHITE BIRCH

PAGE 605

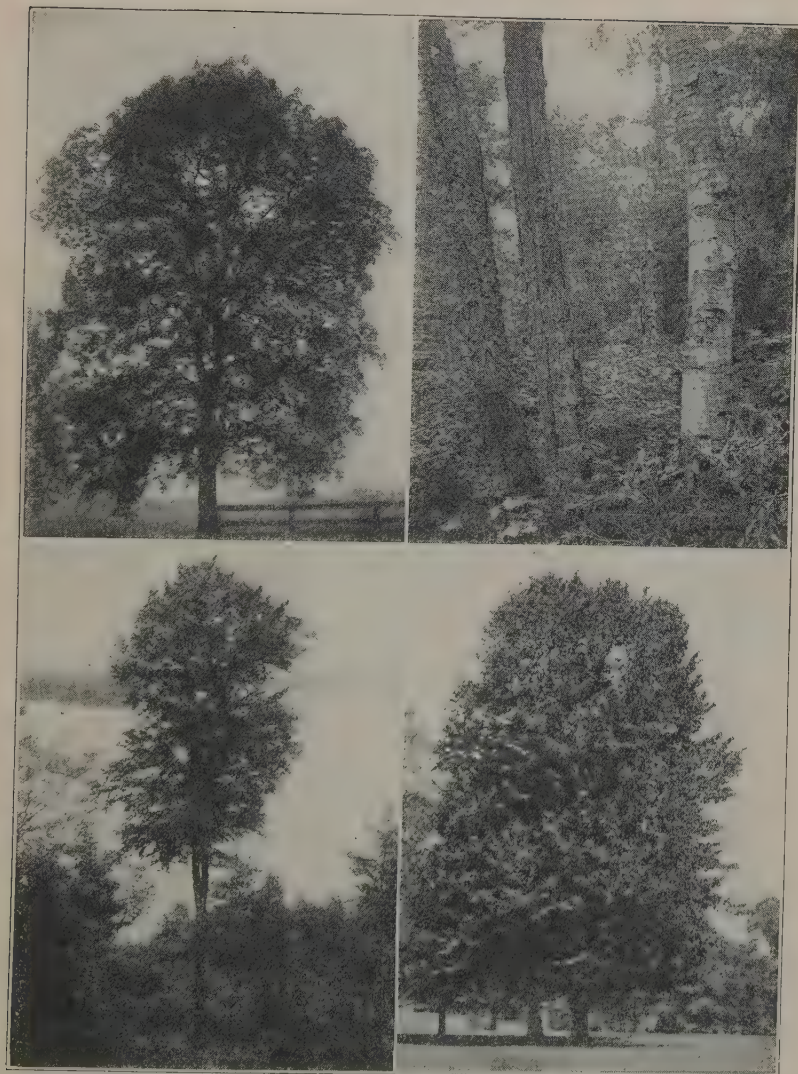
Betula papyrifera

DESCRIPTION: Tree with white bark, separating into thin paper-like sheets; leaves, alternate, simple, toothed.

DISTRIBUTION: Newfoundland to Alaska and south to Pennsylvania.

The white birch has been called the most shy and ladylike of trees because it has a delicate grace and beauty possessed by no other species. The most characteristic thing about the birch is the bark with its horizontal markings and its thin paper-like layers.

The male and female flowers are borne in separate clusters on the same tree (monoecious), the male flowers being on long pendulous catkins and the female flowers on scaly spikes. The flowers appear either with the leaves or before them. The fruit is a thin-winged nut.



*Courtesy, U. S. Forest Service
Photographs by Lazenby, Chapman, American Museum of Natural History, and Mell*

Ohio Buckeye

White and Yellow Birch

Yellow Birch

Basswood

The paper birch is also called the canoe birch because it was so much used by the Indians in making canoes. Many other useful articles are made from the bark.

Other species of birch occur in our American woods, such as the yellow birch, gray birch, and black birch.

SOAPBERRY FAMILY

Sapindaceae

This is a large family made up of trees, shrubs, or climbing plants. Most of the species of this family have radiate compound leaves and showy irregular flowers in erect terminal clusters.

The family takes its name from the soapberry of southern North America, whose berries are used as a substitute for soap. The horse-chestnut and the buckeye are the most familiar representatives of the soapberry family.

BUCKEYE

PAGE 605

Aesculus glabra

DESCRIPTION: Tree of moderate size, whose bark has an unpleasant odor; leaves, opposite, with 5 to 7 leaflets; flowers, green, yellow, or white.

DISTRIBUTION: River bottoms and rich woods from western Pennsylvania to Oklahoma and southward to Alabama.

The buckeye is an attractive shade tree having large leaves with leaflets radiating like the fingers of a hand. The small bell-shaped flowers are arranged in panicles. The common buckeye is sometimes known as the fetid buckeye because of the disagreeable odor of the bark. It is also called the Ohio buckeye, probably because it was first found growing in that state. From this tree Ohio has been nicknamed the Buckeye State. As a matter of fact, the tree is much more typical of regions farther south than it is of Ohio.

A closely related species is the horse-chestnut (*Aesculus hippocastanum*). This tree has large leaves, usually with seven leaflets, and large clusters of very showy white flowers spotted with yellow, red, or purple. The horse-chestnut is native of Europe and Asia and is much cultivated for ornament.

LINDEN FAMILY

Tiliaceae

The chief representative of this family in North America is the linden or basswood, although there are a number of other species in various parts of the world, most of them being trees.

BASSWOOD OR LINDEN

PAGE 605

Tilia americana

DESCRIPTION: Large tree with heart-shaped, somewhat one-sided leaves and creamy flowers in small drooping clusters from the center of a leaflike bract.

DISTRIBUTION: Rich woods from New Brunswick to Manitoba and south to Georgia and Texas.

This is one of the most beautiful and useful of our trees, growing to a height of one hundred thirty feet with a trunk three to four feet in diameter and crowned with a mass of foliage that casts a deep shade. The bark is light brown and smooth when the tree is young but deeply furrowed in maturity. In the winter the basswood may be recognized by its reddish-brown one-sided buds. The flowers are perfect and are suspended from leaflike bracts. When the fruit develops, the bract serves as a sort of sail to carry the seed a short distance from the parent tree. The flowers are fragrant and rich in honey. Bees frequent them in swarms. Basswood honey is one of the most prized of all.

The light wood of the linden is soft but is tough and durable and remarkably free from knots. It is easily worked and hence much used for woodenware and carving.

One of the interesting features of the basswood is that toward maturity sucker sprouts appear around the old trunk. After the old tree dies these sprouts carry on the life of the root for many years longer. Other groups of sprouts may occur at a still later time.

For cultivation the linden has several advantages. It grows quickly, has a superb framework, and beautiful and profuse bloom. One fault is the early dropping of the leaves, which are usually marred by the wind soon after they reach mature size.

EVERGREENS

HOLLY FAMILY

Aquifoliaceae

This is a rather small family of shrubs and trees, with mostly alternate leaves that in many cases are spiny and leathery. The flowers are small, white, or greenish. The fruits are generally more conspicuous than the blossoms.

HOLLY

PAGE 609

Ilex opaca

DESCRIPTION: Shrubs and trees with evergreen, spiny leaves; flowers, white, in loose clusters; fruit, scarlet, berry-like.

DISTRIBUTION: Moist woodlands from Massachusetts to Missouri, Florida, and Texas; most abundant near the coast.

The holly, with its evergreen leaves, has long been associated with Christmas festivities. Its name seems originally to have been holy tree and it was probably so called because it was used to commemorate the holy period of Christmas. The holly grows to a height of forty to fifty feet and has a trunk one to two feet in diameter. The branches are short and slender and the head pyramidal. The bark is gray, and in old trees is usually covered with lichens. The leaves remain on the branches for three years, finally dropping off in the spring season. The white flowers appear in the spring in clusters either at the axils of the leaf or scattered along the young shoots. The fruit ripens late in the autumn and remains on the branch all winter. Each berry contains four large seeds.

Holly wood, which is nearly white when first cut, is used in cabinet-making and in turnery. It is light and close-grained but not strong.

In the southern states there are several other species of holly, most of which are shrubs, and like the Christmas holly, have showy berries. In the northern states there are two common species of holly, the winter berry (*Ilex verticillata*) and mountain holly (*Nemopanthus mucronata*). Both of these species are deciduous, shedding their leaves in the autumn. Their beautiful scarlet berries make a striking feature in the landscape.



Photographs by Lindsey, American Museum of Natural History, Leve, and Block Courtesy, U. S. Forest Service

American Holly

White Pine

Young Western Pine

Balsam Fir

Long-leaf Pine

PINE FAMILY

Pinaceae

The pine family includes the trees commonly called evergreens. It does not include all the evergreens, however. The holly and laurel, for example, belong to another family. In the *Pinaceae*, the leaves are characteristically needle-like or scalelike instead of large and broad as in most other plants. Not all of the pine family are evergreens. The larches of our northern bogs and the bald cypress of our southern swamps are both deciduous, that is, they lose their leaves in the fall. The pines have a resinous juice and the fruit is in the form of a cone; hence these trees are often called conifers.

The pine family includes the pines of various species, the spruce, fir, hemlock, the larch, and cypress, the juniper, cedar, and arbor vitae. This is one of the oldest families in the world and goes far back into past geologic ages. The pine has a simple type of flower. It is in the form of a scaly catkin. The fertilized ones later on become cones, some of these being berry-like, as in the junipers.

WHITE PINE

PAGE 609

Pinus strobus

DESCRIPTION: Evergreen tree with needle-like leaves in bundles of 5.

DISTRIBUTION: From Nova Scotia to Manitoba and south along the Appalachian Mountains to Georgia.

The most characteristic feature of the pine is that its needles are arranged in clusters instead of being arranged singly on the branches. The cones, also, are larger than in most of the conifers and the leaves are generally longer than in the other species of this family.

No tree is of greater economic value than the white pine. Not only is it among the most important of timber trees, but it yields turpentine, pitch, resin, and oil, and is one of the most graceful and beautiful of all our trees. However, the pines do not reproduce so well as other trees. They spread only by seed.

Formerly the white pine was the most important timber tree of the United States and southern Canada but on account of the ruthless devastation of our northern pineries, this noble tree has now taken a subordinate place in the American lumber markets. In all schemes of reforestation in the northern states, the white pine plays an important part. It is important that the government and the various states take active measures to conserve the pines and plant more. In addition to the ravages caused by destructive lumbering and by fires, the white pine has often become the victim of a dangerous fungus, the white pine blister rust, which has destroyed large areas of pine trees in the northeastern states. One of the curious facts of nature is that the fungus which destroys the white pine spends the first part of its life on the gooseberry or currant bush, so that in regions where blister rust occurs, it is quite possible to destroy the fungus by destroying the currant and gooseberry bushes in that region.

Next to the white pine in importance is the Georgia pine (*Pinus palustris*), the needles of which are unusually long, sometimes ranging from ten to fifteen inches in length, grouped in bundles of three instead of five. These leaves grow in thick clusters at the end of the branch. This tree yields very valuable hard, durable lumber for ships and bridges, the interior finish of buildings, and many other purposes. It is the most important source of naval stores, such as pitch and turpentine (see Geography, Vol. VIII). Since the devastation of the northern white pine forests, the southern or long-leaved and other pines have taken the foremost place in the lumber markets of the United States and southern Canada.

FIR

PAGE 609

Abies balsamea

DESCRIPTION: Tree with needle-like leaves, arranged spirally around the branch, appearing two-ranked; cones, very resinous, erect.

DISTRIBUTION: Widely distributed in North America from Newfoundland and Labrador to Alberta and south to the mountains of North Carolina.

The fir is a pyramidal tree of moderate height with widespreading, slender branches. The needles are set singly but appear to be two-ranked because of a twist in the base. The bark is character-

istically covered with blisters, which contain resin known in commerce as Canada balsam. The leaves are very fragrant in drying and are often used as stuffing for pillows. Canada balsam is much used in medicine because of its healing qualities and is also used as a medium for preserving mounted microscopic specimens. The wood is soft and coarse-grained. It is used to some extent for making packing cases. The fir makes one of the most beautiful of Christmas trees. In the western states there are several other species of fir, some of which attain very great size. Among them is the red fir, called by John Muir, "the noblest of the race."

SPRUCE

PAGE 613

Picea

DESCRIPTION: Evergreen tree with 4-sided, needle-like leaves set on woody bases and spirally arranged on all sides of the branch.

DISTRIBUTION: From the Arctic Circle across the continent, south to the Appalachian Mountains.

At first glance, the spruce and the fir appear very much alike, but on closer inspection they are easily distinguished, for in the spruce each leaf is set on a little woody projection instead of joining the twig directly. When the leaves have fallen, the twig appears roughened with these leaf brackets. The leaves, also, are four-sided and have very sharp points, which makes the spruce quite unsuited for making pillows. The cones of the spruce are different from those of the fir in that they hang down instead of being erect.

The wood of most spruce trees makes good lumber and it is especially valuable for paper pulp. This is also one of the popular Christmas trees. The red species (*Picea rubra*) is one of the most valuable of lumber trees. The name comes from the reddish-brown color of the cones and of the branches. The black spruce (*Picea mariana*) has duller-colored bark and cones, and leaves that on the old tree are very dark. The chief use for the wood is in the manufacture of paper pulp. Spruce gum is obtained from both the red and black spruce.

The white spruce (*Picea canadensis*) is one of the handsomest of spruce trees. The twigs and cones are lighter in color than those of the other species. The needles are more slender, and the wood is



Upper photographs by J. M. Fetheroff and E. S. Shipp

Courtesy, U. S. Forest Service

White Spruce

Red Spruce

Black Spruce
fruit

Black Spruce

straight-grained and light yellow in color, and is effectively used for interior finishings. Other important species of spruce grow in the western states. One variety, known as Sitka spruce, is much used in connection with the making of airplanes.

HEMLOCK

PAGE 615

Tsuga canadensis

DESCRIPTION: Evergreen tree with needle-like leaves, spirally arranged about the branches but appearing two-ranked.

DISTRIBUTION: This tree abounds in the rocky woods of the North and extends from Maine to Minnesota and south in the mountains to Alabama.

The hemlock is one of the most graceful of evergreen trees, with plumelike drooping branches which give the effect of feathery lightness. The blunt needles are dark green, much paler on the underside. The cones are oval, usually a reddish-brown in color. When the needles of the hemlock are examined closely, it will be seen that each one has a short petiole or leaf stem quite different from the other conifers.

The hemlock is sometimes used for rough lumber, but its chief commercial value lies in its bark, which is used in tanning. The hemlock is sometimes used as a Christmas tree.

RED CEDAR

PAGE 615

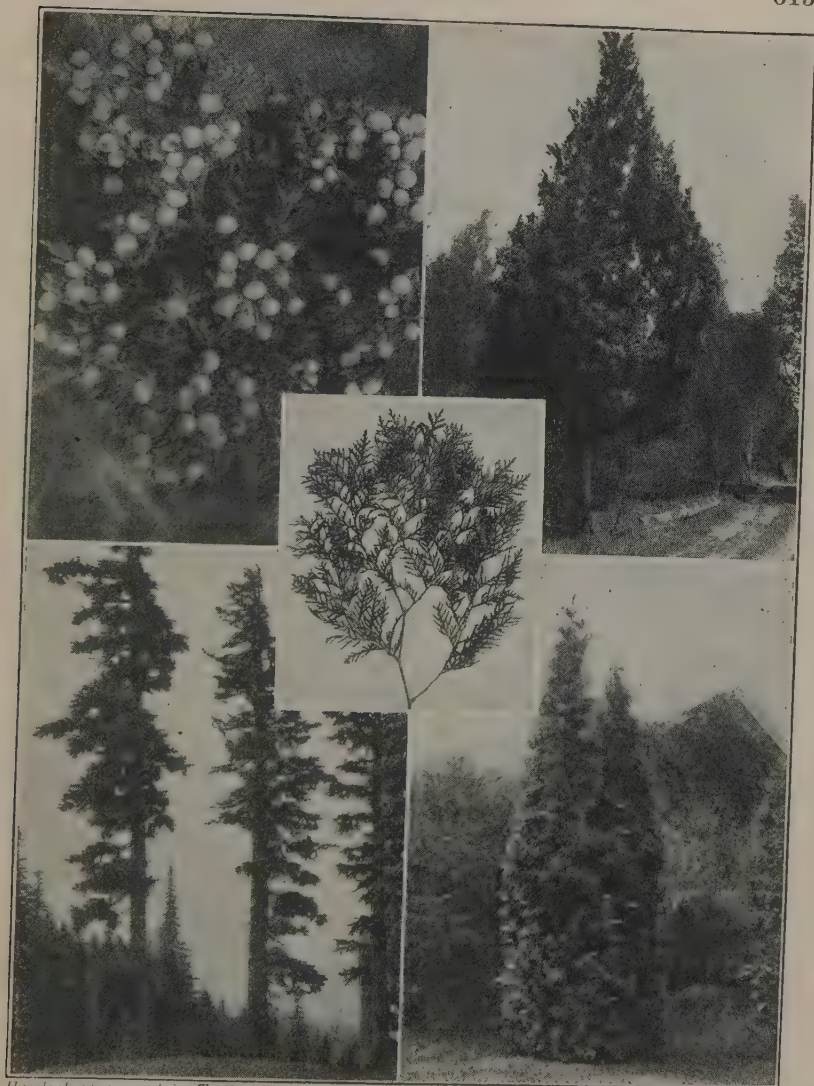
Juniperus virginiana

DESCRIPTION: Shrub or tree with opposite scalelike leaves and berry-like cones which are bluish-black, with white bloom.

DISTRIBUTION: In dry soil from Nova Scotia to South Dakota, and south to Florida and Texas.

The red cedar is a striking feature in the landscape on account of its tall, slender, pyramidal form. The foliage is dark, in winter sometimes becoming tinged with russet. The scales of the cone, instead of hardening and remaining separate, become thick and fleshy and grow together in the form of a berry.

The wood of this tree is fragrant and of a dull red color. It is close- and straight-grained and durable, and makes the best lead pencils and cigar boxes. On account of its odor, few insects will attack it and it is much used, therefore, for making chests and for



Hemlock photograph by T. H. Gill

Lower photographs, courtesy, U. S. Forest Service

Red Cedar
fruit

Red Cedar

Mountain Hemlock

Arbor Vitae
leaf

Arbor Vitae

closet linings to keep moths away. It also makes good posts and railroad ties.

A closely related species is the common juniper (*Juniperus communis*), which is a spreading shrub instead of a tree. The leaves are needle-like and are arranged in threes.

ARBOR VITAE OR WHITE CEDAR

PAGE 615

Thuja occidentalis

DESCRIPTION: Small evergreen tree with flat scalelike leaves covering fanlike branchlets.

DISTRIBUTION: Mostly in swampy soil or along streams from New Brunswick to Manitoba and south along the Alleghenies to North Carolina and Tennessee.

Arbor vitae means "tree of life" and it is thought that this name was given because of the use of its bark and twigs in medicine and also because of the unusual durability of its wood. The scientific name comes from the Greek word meaning "sacrifice," the wood having been much used in sacrificial offerings because of its pleasant odor. The foliage has a fanlike appearance and is very beautiful. The small oblong cones are pale cinnamon-brown in color.

Arbor vitae is a very ornamental tree and is often planted in hedges and elsewhere. On account of its durable wood it has been used for making cedar block pavements.

Henry C. Cowles

CAMP COOKERY FOR FIELD TRIPS



By

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CAMP COOKERY FOR FIELD TRIPS

YOU must go to Nature herself if you would identify and appreciate her. The preceding material in this volume cannot be mastered from the book page, but it has been prepared as a guide and as a check on the field trips which are absolutely necessary in the successful teaching of nature study. On these trips the teacher has an opportunity not only to teach the subject of nature but to teach the children how to cook and look after themselves and also to give demonstrations of first aid in the case of accidents (see Health, Vol. I, p. 392).

A field trip is more interesting, enjoyable, and valuable if a good luncheon prepared by the members of the expedition is one of its features. The writer has taken many groups on field trips and hikes. We have taken no cooked food with us on these trips. We have prepared our meals in such a manner that all have been satisfied and busy, and most of us continue to be eager for other trips, knowing that we will not have a case of indigestion following a trip. On one occasion the writer had between 160 and 170 boys on a trip in California, over comparatively new country, with a minimum of assistance. On none of these trips has the cost of a meal sufficient to satisfy the campers exceeded twenty cents per person, and in some cases an assessment of this amount has permitted the purchase of a complete set of cooking utensils

in addition to paying for the food. It is concerning this kind of culinary economics that this article is written.

To make a camp-cooking trip a success educationally as well as gastronomically, one should provide for a variety of foods which may call for a variety of types of preparation. To be most successful, one should so plan the time spent in preparation of a meal that all campers will be kept constantly busy and will begin eating at approximately the same time and finish at about the same time. If this is not done, all sorts of unpleasant incidents may arise.

For convenience, this is being written on the assumption that a camping party will number ten. Should the number be larger or smaller, adjustments may be made in the matter of amounts of food purchased, of course. Let us for our first meal have corn chowder, cinnamon toast, pancakes, and cocoa or, if conditions permit, sassafras tea.

FOOD MATERIALS AND COOKING EQUIPMENT

WHAT TO BUY. For each unit of ten persons on this hike, buy the following materials: two loaves of bread, one-half pound of butter, one pound of sugar, one medium-sized can of tomatoes, two cans of corn (or you may prefer to buy one can of corn and one of peas), four medium-sized onions, ten medium-sized potatoes, one small package of pancake flour, one small can of cocoa, one small can of milk flour such as Klim (this will be more than will be needed for ten people and the surplus may be used on subsequent trips), one-half pound of rice, one small can of cinnamon. Spend whatever money you have left out of the budget for bacon. You can get along satisfactorily on one-half pound for ten people, but you might as well have two pounds if your allowance will permit. This list of supplies is made on the assumption that you will have matches and salt with you anyway, whenever you camp, and so these are not included.

DESIRABLE EQUIPMENT. While a trip may be successful with less cooking equipment than is here listed, it would be



desirable on this proposed trip to have two two-gallon pails, two two-quart pails, two small ten-cent frying pans and a larger eight- or ten-inch frying pan, and a can opener. This equipment will be adequate for the needs of a few more than twenty persons, though it may cause some inconvenience if that many are to be served. Additional equipment should be made in the matter of more small frying pans, where this is feasible, when twenty are to be served. Each child should bring a tin cup, knife, fork, and spoon. This equipment can be easily carried in army knapsacks strapped on the shoulders of the boys. The load can frequently be shifted from one boy to another.

ORGANIZATION AND PREPARATION OF THE MEAL

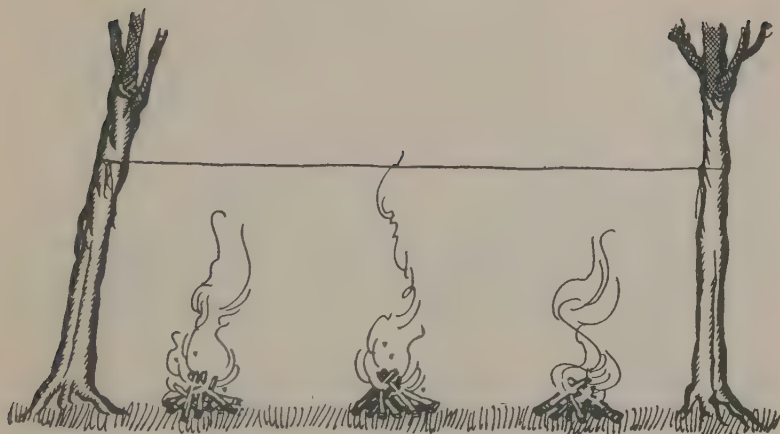
PLANNING THE TRIP. It is assumed, of course, that the teacher has previously been over the route of the proposed hike, has determined the starting point, made special note of what is to be observed along the route, the approximate place where the group will be at luncheon time and the route to be followed, and the things to be observed after luncheon.

Good water and available firewood are the principal things to consider in selecting a camp site. Unless the water used is from a deep well or from a spring known to be pure, all water used for tea, cocoa, or coffee should be boiled at least ten minutes.

HOW TO ORGANIZE YOUR GROUP. One way to judge whether or not an outdoor meal is succeeding is to notice whether people are running about. In a properly organized group, there should be no need of anyone's moving about to any great extent, once the fires are lighted. Since the preparation of this meal will involve at least three types of fires, it is well to divide your group of ten into three small groups of three each, the tenth person being the one responsible for the success of all. Should your group be larger than ten, you may recruit each of the three units up to eight in number without increasing the number of fires. This will permit three fires to care for twenty-five persons, the amount of food, of course, being increased to care for the additional appetites.

For convenience, let us outline the activities of each of the three groups separately. Before doing this, however, there are a number of things worthy of note which apply to all. There are three essential types of activity in which each group will be engaged: the collecting of firewood and its preparation for use in the fire, the building of the fire and cooking of the food, and the preparation of the food for cooking. To some degree, these duties overlap, but good campers are always ready to help where help is needed. For convenience, then, let the three individuals in each of the groups assign themselves to one or another of these activities. The individual collecting firewood will assume the duties of fire-tender when the cook has to abandon attention to building the fire in order to engage in cooking.

SELECTING THE FIRE SITE. Much of the success of a group activity of this sort depends upon the selection of fire site, so that no group will have to "eat" the smoke of the fire of some other group. To avoid this, determine in which direc-



The fire-race arrangement

tion the wind is blowing and stretch a string over the proposed site at right angles to the direction of the wind. Have the fires built under the string. If you wish, you may make the burning off of the string a contest, in which all are permitted to build their fire material up to within eight inches of the string and all light their fires simultaneously. The group first burning off the string naturally wins this event. The writer has been on a trip on which there were thirty small cooking fires, each accommodating five or six people, and none was annoyed by the smoke which arose from this large number of fires.

Fire sites should be selected with care. They should not be on ground covered with dry material, which may catch fire and continue to burn. Such material should be cleared away from any proposed site, if it is present. Neither should fire sites be built over shale rocks that are well filled with water, unless you wish to enjoy the benefits of a holiday celebration, when the rocks blow up and spread your dinner over the landscape.

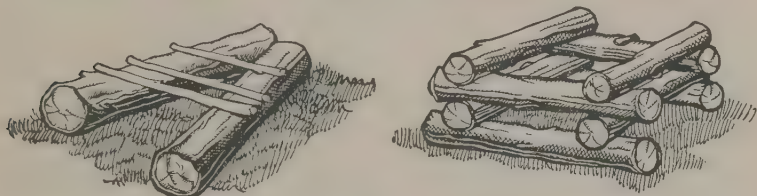
None of the fires here considered need be over six inches wide and a foot long to be successful. Small fires are more successful than large fires, which may not be approached.

THE FIRST FIRE. On this proposed trip, the first group may build a fire especially planned for *frying*. Probably the best fire of this type is the *hunters'* and *trappers'* fire. To make such a fire, dig a trench about six inches deep, a foot wide, and a little more than a foot long. The long axis of this trench should be placed so that it is slightly different from the direction in which the wind is blowing but not at right angles to it. Line the trench with small stones and at its sides place two logs three or four inches in diameter and a foot and a half long so that they form a very deep V that is not completely closed at its apex. The apex should be away from the direction from which the wind is coming. The logs used may be waterlogged or may be deliberately soaked in water if you wish. Build the fire between these logs by laying a single stick across the logs. Under this stick place a mass of dried weed-tops or twigs from a dead tree-top, and over this and against the stick lean small dry sticks. Light the tinder and keep adding small sticks until the fire is strong enough to permit the addition of larger material. When the space between the logs is well filled with burning fuel, you may cook over such a fire from the side from which the wind is coming with perfect ease and comfort.

While the first group is engaged in making this hunters' and trappers' fire, one member of the group should secure from the general supplies the following food materials: at least one-quarter pound of bacon, the four onions, two-thirds of a loaf of bread. He should also secure the large frying pan. Into the frying pan, he should put the bacon after cutting it up into small pieces, none over an inch long. He should warm the bacon over the fire until grease begins to appear and then add the onions, which he has in the meantime sliced up. He should cook the onions and bacon over the fire, keeping them stirred. When the onions have ceased to be stiff, this group has done its duty so far as the chowder is concerned and may devote its energies to its own interests. As a general thing, by the time those at this fire have the onions and bacon well cooked, the other groups will be ready to take them for

the chowder, so that the frying pan will be free for the making of pancakes, the batter having been prepared at another fire.

THE SECOND FIRE. The second group with which we are concerned is asked to build a fire suitable for *boiling* the

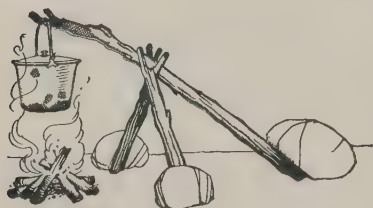


The hunters' and trappers' fire (left). If the logs are too far apart to support a pail or pan, green sticks may be laid across. At the right is shown the log-cabin formation for starting a fire

potatoes. A combination of the *crisscross* and *log-cabin* fires is a good type for this purpose. To build such a fire, select a goodly quantity of sticks about a foot long and as large around as your thumb. Lay two of these on the ground parallel to each other and about ten inches apart. Across their extremities, lay two others, and continue in this fashion until you have built up a "log cabin" eight or ten inches high. In the center of this log cabin, erect a pyramid of very fine material surrounded by coarser material. Light the fine material and keep the log cabin filled with loose material until everything is blazing merrily. Over such a fire, you may suspend a pail containing anything you wish to boil, and, if conditions permit, the pail may be lowered so that it is surrounded by the blazing "cabin" and the boiling process is accelerated. Such a fire as this may be converted into a frying fire, when the fuel has burned down, by the addition of logs to either side, arranged much as are those in the hunters' and trappers' fire.

Camping books are full of suggestions for suspending a kettle of water over a fire, but most of them require the driving of a stake into ground which may be full of rocks. An outfit which will permit a boiling kettle to be suspended over a fire at any desired height may be set up on a pavement,

into which no stake could possibly be driven. To do this, you will need at least three large heavy rocks, a pole about five or six feet long, and two stout forked sticks, each from a foot and a half to two feet long. Place two of the stones near the fire and about eight or ten inches apart. Place the



A simple crane

third stone three or four feet away from the fire on the side on which you have placed the other two. Hold the two forked sticks fork up and together, with their unforked ends against the first two stones. Place the long stick so that it is supported by the two forked sticks and has one

end against the large rock and the other end over the fire. On this free end suspend whatever you wish to boil. If you wish to lower the material being boiled, simply spread the ends of the two forked sticks and if you wish to raise the material bring these ends closer together.

The second group, while it is engaged in building a log-cabin-crisscross fire and a crane for boiling food, should have one of its members secure from the general supplies the following: the potatoes, the corn, the tomatoes, and two-thirds of a loaf of bread. He should also secure one of the large pails and one of the small frying pans. He should first put the potatoes in the pail to see about how much space they will occupy and then, after removing the potatoes, he should put in enough water to just cover the potatoes. This pail of water should be put over the fire as soon as possible. This camper should then engage himself in paring, washing, and dicing the potatoes. When this is done, they may be put into the water and boiled until they are soft. The potatoes should be done at about the same time that the onions and bacon are finished at the first fire. While the potatoes are coming to a boil, the canned goods may be opened and made ready. Before giving final directions in making the chowder,

let us go on to the group at the third fire and see how it is engaged.

THE THIRD FIRE. Those engaged in making the third fire should proceed in much the same manner as those engaged in making the second fire, building the same type of fire but building two of the adjustable cranes. One of these cranes should be large enough to support one of the large pails, and the second should be large enough to support one of the small pails. One of these pails should be used for preparing the rice and the other for preparing the cocoa or the sassafras tea.

The individual in this third group not engaged in making the fire and cooking equipment will have a busy time of it. He should secure from the general supplies all that remain, namely, the sugar, the cocoa, the milk flour, the rice, the pancake flour, and the remaining bread. He should also secure what is left of the equipment—the two small pails, one large pail, and one small frying pan.

Cocoa. To make the cocoa, the camper should first place in the large pail about two or three cups of water more than are needed of cocoa. This large pail should be suspended over the fire as early as possible and the water brought to a boil. While this is being done, the camper should mix equal quantities of cocoa, milk flour, and sugar, allowing one teaspoonful of each for each cup of cocoa to be made and mixing the whole thoroughly in the small pail. When these ingredients have been thoroughly mixed, they should be put aside, possibly in a paper sack, and added slowly to the water when it



Courtesy, E. Laurence Palmer

has come to a boil. If the water is stirred while the cocoa is being added, undesirable lumps will not be formed. After the cocoa has been boiled a very short time it will be ready to be drunk.

Sassafras tea. If sassafras tea is desired in preference to cocoa, and sassafras root is available, it may be made easily. To do this, dig a fresh root of a sassafras shrub which would not normally develop into a healthy tree. Two pieces as large around as your thumb and six or eight inches long should be more than enough for ten or a dozen campers. Wash the root. Cut off the above-ground portion. Slice the root, bark and all, into a pail of water. Bring the mixture to a boil and add sugar to suit your taste. Remember not to throw the bark of the root away, and boil a short time or a long time as may suit your individual taste.

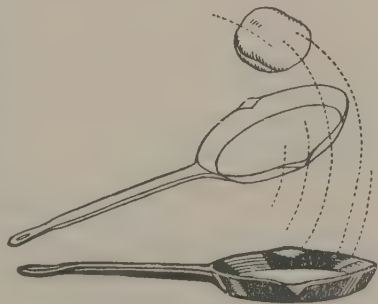
The mixing of the ingredients of sassafras tea or cocoa need take but a few minutes. The individual doing this may then also be assigned the task of preparing the rice.

Boiled rice. Wash a couple of handfuls or more of rice in cold water to which salt has been added. This may be done in the pail in which the cocoa was mixed. In the meantime, have the other small pail over the fire filled with water. When this water has begun to boil vigorously, add the rice slowly, so as not to stop the boiling. Continue the boiling for about twenty minutes without stirring. Pour off the water at the end of the twenty minutes and then raise the pail above the fire so that the food will not burn, and allow the kernels to swell and dry. The longer you can permit this to go on the better. If you wish to eat the rice as a separate dish, you should allow it to stand for at least a half-hour. You should prepare from a half to three-quarters of a pound of rice, if you wish an abundance of it to be eaten by the ten persons as a separate dish. The rice may, however, be used in the chowder without allowing it to stand so long.

FINISHING THE CHOWDER. Now let us assume that the first-fire group has prepared its bacon and onions, and that the second-fire group has prepared its boiled potatoes and

the third-fire group, its rice and cocoa. The cook in charge of the potatoes at fire two should pour off the potato water. To the potatoes, he should then add the onions and bacon cooked at fire one and the rice cooked at fire three. He should also add the canned tomatoes and all but one-half can of the corn. The chowder should now be stirred vigorously with a large stick and suspended over the fire high enough so that it will not burn. It should be stirred at intervals until the mixture has become steaming hot. It is then ready to eat. At the same time, the cocoa or sassafras tea will be ready to be drunk, but this may wait.

CORN PANCAKES. In case some one of the party has free time, the leader of the group should assign to him the preparation of the pancake batter. The small pail in which the cocoa ingredients were mixed may be used for mixing the pancake batter, after it has been washed out. To do this, fill the pail nearly half full of water and add pancake flour, while stirring the water, until you have a rather heavy batter. To this, add one-half can of corn and mix the whole thoroughly. Batter containing corn should be made slightly drier than ordinary pancake batter, because of the moisture in the corn. To cook the pancakes, first fry a strip of bacon in the frying pan. Pour off the surplus grease by turning the pan over once. Put the batter in the pan and cook over the fire until one side is done. Pound the pan on the log beside the fire to free the pancake, or loosen it with a knife. When one side is done, flip the pancake by a forward and upward motion of the pan and proceed to cook the other side. In a group such as we have been considering, each individual may cook his own pancake, using the batter which was mixed for the whole group. Butter is an addition to corn pancakes but



Method of flipping a pancake

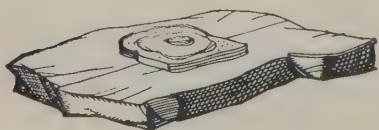
is not essential. The pancake may be cooked satisfactorily if it is made with a strip of bacon inside of it. This is done by pouring the batter in the pan over a strip of cooked bacon. If this does not suit your taste, try making a sandwich by folding the cooked pancake over a strip of cooked bacon.

Make your toast over the embers, adding butter, sugar, and cinnamon while it is hot.

OTHER USEFUL RECIPES

"HOT DOGS" AND BACON SANDWICHES. These sandwiches are simple to prepare and most appetizing. They may be made either with sandwich buns or with bread. Only the best grade of wienerwursts should be purchased for the "hot dog" sandwiches. Small sticks, a little larger around than a pencil and three or four feet long, should be cut. Any variety of willow or dogwood is good for this purpose. The small end of the stick should be sharpened and this should be inserted lengthwise through the "weenie," which is held over the fire until thoroughly toasted. It is well to hold it until the skin pops on all sides, and then the "hot dog" is placed between the slices of bread; mustard and pickles will add flavor. Bacon sandwiches are prepared in much the same way. Strips of bacon are put on the end of the sticks. These are held over the fire for but a few moments, inserted in a roll, and the sandwich is ready.

EGGS. Eggs may be boiled easily with other foods, if you desire. They may also be fried in a pan or they may be cooked on a stone. In the latter case, select a stone that is perfectly dry, such as may be found on a stone wall. It must



An egg fried in a slice of bread

also be flat on at least one face. Place this face uppermost and heat the stone by means of a fire. Place a strip of bacon on the hot face, and when the face has become grease-cov-

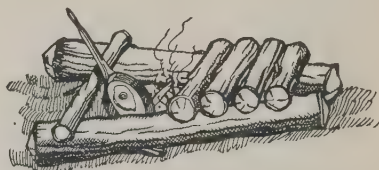
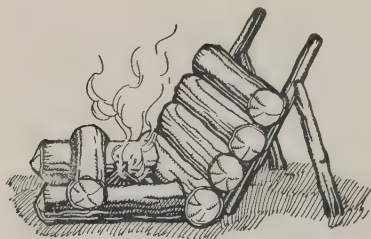
*Courtesy, E. Laurence Palmer*

ered, place on it a piece of bread from which a circle the size of an egg yolk has been removed. Into this hole, break an egg and allow the white of the egg to cook fast to the lower side of the bread. Then turn the bread and egg by means of the bread.

STEAK AND EGGS. Eggs may also be cooked on a piece of steak over an open bed of coals. To do this, place a thin slice of steak larger than an egg on a bed of coals. When one side is cooked, turn the steak so that the cooked side becomes concave and the uncooked side is embedded in the coals again. On the cooked surface, break an egg and bank the whole with coals. The heat of the cooked steak and the coals will cook the egg. Some call this "egg on horseback."

BAKED POTATOES AND CORN. There are a number of camp dishes that are best cooked over a slow fire. These are generally secured by means of "reflectors" such as are shown in the illustration on the following page. Such fires are useful in making breads and the like.

In such a fire, potatoes may be baked by first wrapping them in a thick layer of mud or clay. If they are then tossed



A reflector fire (left) and a hunters' and trappers' fire modified to produce heat for baking

into a fire and allowed to cook for about forty-five minutes they should be as delicious as any prepared at home in an oven. Corn may be roasted similarly, if the ears with the husks still on are first wrapped in a layer of mud and clay.

CAMP BISCUIT. A convenient recipe for camp biscuit is the following: For each biscuit desired, take all the flour you can hold in one fist and put it in a cup or paper sack. To this, add as much baking powder as you would normally hold between the thumb and two adjacent fingers. Add, further, as much salt as you get between a thumb and first finger. Mix these thoroughly and to them add a "gob" of butter, which may be defined as the amount of butter you get by bringing your thumb backward up through soft butter. Mix this into the other materials. Make a hole in the mixture with your finger and fill this hole with water. Stir the water with your finger, so that you have a mass of dough of increasing size forming on your finger. Mold or knead this between your hands until it is of good texture and easily handled. Then bake in a frying pan in a reflector fire, or bake it by wrapping it around a large stick in a spiral, leaving room for expansion between the spirals. Fill the cooked spiral with crisp bacon and you have a good meal.



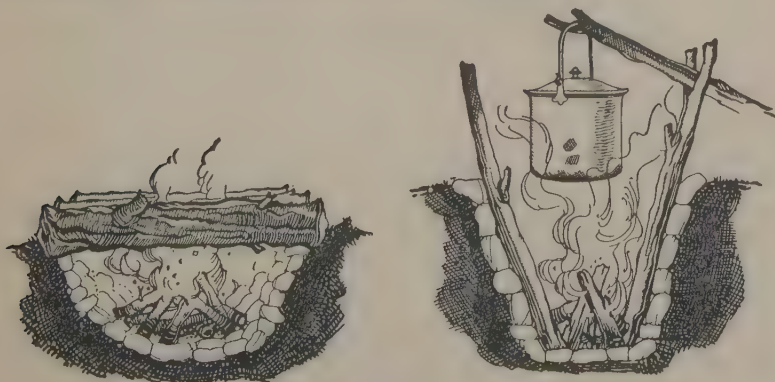
CORN-MEAL BREAD OR JOHNNYCAKE. To make this you need only corn meal, salt, and water. To whatever amount of yellow corn meal you have, add three-fourths as much warm water and flavor with a very little salt. Stir the mix-

ture thoroughly and bake for about forty-five minutes in a good reflector oven.

BEANS. We have already treated most of the staple camp foods such as rice, bacon, and johnnycake. There still remains that old reliable dish—beans.

To cook beans you need a pail, the beans, and some sugar, salt, and salt pork. A pound of pork and a pint of navy beans will fill about four stomachs for one meal. To make bean soup, soak the beans overnight if possible. Put the beans in cold water and bring the water to a boil. Boil them for a half-hour. At the same time, boil the salt pork separately. Pour the water from the beans into a container where it may be used again. Mash the beans and add the pork to them. It is sometimes worth while to add a little flour at this time. Pour the bean water back onto the beans and boil the mixture *very slowly*, so that it will not burn. You then have a very good bean soup.

To bake beans, proceed as already outlined for bean soup through the first boiling. Place half of the pork on the bottom of a kettle and pour the boiled beans over it. Put the remainder of the pork on top of the beans; add salt, and, if you wish, sugar. Pour back some of the water from the beans and cook slowly in a fire in which they cannot burn, using, preferably, what is known as a “bean hole.”



A bake oven (left) and the automatic stew fire

A bean hole is made by digging a hole slightly larger and deeper than your bean kettle and lining it with stones. On these stones, build a fire, which should be maintained until the stones and surrounding earth are thoroughly heated. Remove most of the overlying live coals and sink the bean kettle in the pit. Cover the whole thing with other coals and, if you wish, with grass and dirt. The beans should be well cooked in four or five hours if the hole has been thoroughly heated.

REFERENCES

There are of course a goodly number of other recipes for cooking meals in camp. Among the references for this sort of thing which might be found useful are the following:

DEMING, AGATHE. *Camp Cookery Hints for Leaders*. Ithaca, N. Y.: The Comstock Publishing Co.

PALMER, E. LAURENCE. *Camp Fires and Camp Cookery*. Ithaca, N. Y.: The Comstock Publishing Co.

SMITH, CHARLES F. *Games and Recreational Methods for Clubs, Camps, and Scouts*. New York: Dodd, Mead and Co.

Caution: Be sure to put your fire out completely.

A handwritten signature in dark ink, reading "E. Laurence Palmer". The signature is written in a cursive style with a large, stylized initial "E" and a long, sweeping underline.







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